9

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, January 10, 1894.

27

PRESIDENT CHAMBERLAIN occupied the chair, and announced as the subject for discussion at the next meeting, "Lubrication of the Journals on Rolling Stock, and the Cause of Hot Boxes, and What can be Done to Obviate Them," to be opened by Mr. F. D. Adams.

Secretary F. M. CURTIS was called upon to report in regard to the matter of a hall for the use of the Club, and stated that Wesleyan Hall, in which the present meeting was held, could be secured for the use of the Club for such months as the Club held its meetings, with the exception of September, and as no meeting was usually held in that month by the Club, but an excursion was substituted, the hall would not be required at that time.

On motion of Mr. Adams the Secretary was instructed by vote of the meeting to secure the hall for the use of the Club for the ensuing year.

The President urged upon the members of the Club the importance of using their personal efforts to increase its membership; and also requested them to be more prompt in assembling for the regular meetings. He stated that hereafter the meetings would commence promptly at 7.30 P. M.

He announced as the subject for discussion for the evening, "Railroad Building, with Reference to Economy of Operating," to be opened by Professor C. Frank Allen of the Boston Institute of Technology.

Railroad Building, with Reference to Economy in Operating.

By C. Frank Allen, *Member Am. Soc. Civil Engineers.*

In the building of railroads the civil engineer is needed in three reasonably distinct capacities.

It is necessary, first, that some one should be employed who can readily do the work of laying out curves for track and other purposes, who can properly set stakes by which earthwork and masonry may be put in proper place, and who can calculate the amount of work performed. These duties may be considered to constitute the surveying work of railroading. They require facility in the use of instruments and a satisfactory knowledge of the application of ordinary mathematics. Work of this kind is as a rule the work of the younger or subordinate members of an engineer corps, and although among the best known of engineers' duties, may be ranked as among the least important.

It is necessary, secondly, that any structures to be erected shall be designed so as to be certainly safe, and, in addition to that, of as low first cost as may be consistent with safety; the structures must be also well and faithfully put together. Here again the work of the civil engineer is well recognized as essential, as in the designing of bridges which shall be perfectly safe, and yet as simple and light as possible, and so of minimum cost. The design must be followed by suitable inspection of material in the shop and in the place of the work. Retaining walls and other structures require similar attention. Work of this grade is distinctly engineering work, and requires for its performance a knowledge of the principles of mechanics and the properties of materials. Attention is called to the fact that the engineer is needed to do this work if it is to be done at all; but in addition to that it should be borne in mind that the engineer has it in his power to save to his employer, by virtue of his skill and judgment, more by far than is paid him in salary.

It is necessary, thirdly, that the railroad as a whole, and that the various parts of it, shall be arranged and constructed in such fashion as to lead to convenient, safe, and economical operation. The civil engineer for this work must consider not only economy in first cost, but also, and

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FRANCIS M. CURTIS,
Secretary.

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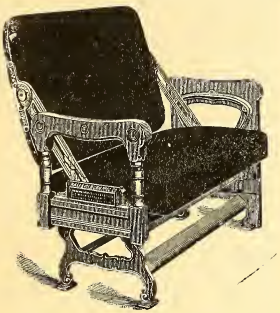

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in connection with it, economy in daily, monthly, or yearly expense in conducting traffic. Such work requires knowledge of the mechanics of bodies in motion as well as at rest; a knowledge of methods and details of doing business, as well as of the properties of materials. Furthermore, in operating expense, a loss or saving, apparently small, through repetition perhaps many times a day, will in a year become large, and the capitalized value at a suitable rate of interest larger still, and may often reach a sum for which most of us are quite unprepared. The work of the civil engineer in this direction has been, and perhaps now is, less perfectly understood, but is, in the opinion of the writer, that requiring the highest order of ability, and in which the greatest opportunities for saving or waste occur. It is for this reason that this paper is to deal especially with this peculiar function of the engineer.

In locating a line of railroad the ideal line is a line straight and of uniform grade between the terminal points. Such a line is seldom seen, for the reason that the large cuts and fills necessary would usually prohibit such a location. If deviations from the ideal line are made, they ought not to be made haphazard, or even according to the caprice of the locating engineer, but only so far as it appears that economy will result from such deviation. The resulting economy must depend in part upon the cost of construction, but must also be based upon a full consideration of the cost of operating the railroad. It needs only the statement of the fact to carry conviction, if it be stated that an increase of distance, of the amount of curvature, or of grade, will occasion a disadvantage sufficient to justify an appreciable expenditure to avoid it. It is further true that an increase of "rise and fall" is attended with a similar disadvantage. Wherever adverse grades occur in passing from a higher to a lower point on a railroad, the "rise and fall" is the amount of rise in vertical feet of all such adverse grades. It has been recognized for very many years by at least a few engineers, that some allowance should be made in favor of a straight and level line, and that certain methods of procedure should be prescribed to determine what that allowance should be. As early as 1838 the subject was called to the attention of English engineers. Since then, from time to time, methods differing in detail among themselves have been proposed by engineers in Great Britain and on the Continent. The effect of curvature and of grade has been the only point investigated by foreign engineers, so far as the writer knows. A common method of procedure has been to find the "virtual length" of each line under consideration, and make an allowance in favor of the line having the shortest "virtual length."

If we know the resistance to be overcome by the engine on curves

and on grades, as well as on a straight and level line, we can readily figure out the distance on straight track which will give a resistance equal to a given amount of curved track. We can find also the distance which will cause the same resistance as a given amount of grade of known rate. If, then, we take the actual length of line, add to this the distance which equates for curvature, and add again the distance which equates for grade, the total will be the "virtual length" of the line, or the length of the straight and level line which will require the same mechanical work from the engine as the given line with curves and grades. The treatment of the question in all these methods thus laid down, or in the formulas given, seems to the writer to be inadequate. There seems to be no recognition of the fact that certain parts of the expense in operating are independent of the mechanical work done by the locomotive, and of those dependent many are not doubled when the work of the locomotive is doubled; there is therefore no recognition whatever of the fact, which is certainly true, that the addition of a mile to the length of an operating division does not add to the expense an amount equal to the average cost of running a train one mile. American engineers now investigate the effect of distance, curvature, rise and fall, and grade, upon the general principles laid down by Wellington in his "Economic Theory of Railway Location." The method adopted is, in brief, to consider each detail of operating expense, and determine, as wisely as we may, the effect of curvature, of grade, of rise and fall, or of increase of distance, upon that one item. The summation gives the total effect.

On most railroads it is known how much it costs to run a train one mile, and how much is to be assigned to the special items going to make up the operating expense. The statistics of the United States Census for 1880 show details of expense for the average of the United States as follows: —

	Per cent.	
Fuel for locomotives	9.31	
Water supply	.68	
Oil and waste	1.06	
Repairs of locomotives	6.19	
Total engine		17.24
Repairs, passenger cars	2.99	
Repairs, freight cars	6.40	
Passenger car mileage	.23	
Freight car mileage	2.21	
Total cars		11.83

	Per cent.			
Engine service wages	7.72			
Train service, passenger	2.85			
Train service, freight	5.64			
Train supplies, passenger	.33			
Train supplies, freight	.36			
Total train wages and supplies . .		16.90		
Total train expenses			45.97	
Repairs road-bed and track	11.23			
Renewals of rails	4.89			
Renewals of ties	3.04			
Repairs of bridges	2.55			
Repairs of buildings	2.17			
Repairs of fences, crossings, etc. . .	.42			
Total maintenance of way . . .		24.30	24.30	
Total transportation expenses . .				70.27
Loss and damage, freight	.28			
Loss and damage, property and cattle	.31			
Loss and damage, passengers . . .	.39			
Total loss and damage		.98		
Agents and station service	10.42			
Station supplies	.81			
Telegraph	1.01			
Taxes	3.77			
General officers and clerks	3.46			
Legal	.70			
Insurance	.26			
Stationery and printing	.76			
Agencies and advertising	1.34			
Contingent and miscellaneous . . .	6.22	28.75	29.73	29.73
Grand total				100.00

Distance. — Having then the details of operating expense, how much can we profitably spend to avoid an increase in the length of line, so that an operating division may be kept at 100 miles in length, rather than increased to 101 miles? What will be the cost of one additional mile? Looking critically at the matter, it appears that very

few of these items would be, for an extra mile, increased exactly in proportion to the distance. For instance, fuel is consumed in stopping and starting, in banking fires; even in standing still heat is radiated so that altogether the increase for fuel on an extra mile will be probably only 67 per cent of that consumed on the average. Engine and car repairs, in a similar way, are not all occasioned by running on the open line. There are various items entering into the average cost; the effect of age, of stopping and starting, of making up trains, of grades and curvature, will all enter into the cost, and as a result 35 or 40 per cent only will be found to properly apply in the case of an extra mile. Some items are practically unaffected by a slight increase in length of line, as the station, general and terminal expenses, and some others. Train wages will or will not enter into the cost, dependent upon whether the wages are paid on a mileage basis, or by the day or trip. Car mileage will increase directly with the distance, or will increase 100 per cent, and perhaps the same is true of repairs of roadbed and track, and renewals of rails and ties.

Each item is investigated in this way, and summing up the effects, it appears that when the average cost of a train mile is $1.00, the cost of an extra train mile is not $1.00, but perhaps 35 cents. For any other cost of train mile the result would be in proportion; for instance, for a train mile cost of 80 cents, the increase would be 28 cents instead of 35 cents.

The more trains there are running over the line, the more the expense of hauling them over this extra mile. For a daily train each way (say No. 1 out, and No. 2 in), we should have in a year 730 extra train miles; at 28 cents per train mile, this would amount in a year to $204.40. Again, in order to take care of this $204.40 per year, we may consider that we set aside a sum of money which at interest will produce this sum. At five per cent this capitalized sum will amount to $4,088. Then this $4,088 is the sum which we can afford to spend in order to save one mile of distance, if we have one train only each way daily. If we have ten trains each way daily, we can afford to spend ten times as much, or $40,880, in order to save a mile of additional distance. For 25 trains each way, we can expend $102,200 to save a mile, or $19.36 to save even a foot of distance. This expenditure is justified, it should be borne in mind, in order to save in operating expense.

Where a saving of five or ten miles is in question, one additional station may be necessary, and certain items will then enter in which were not considered for one mile or less. So that for ten miles we must use a slightly greater value per mile; it is hardly necessary to follow this out in full.

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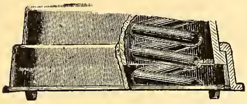

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Curvature. — In a similar way, it costs something extra to haul a train around any curve; the longer the curve, the greater the extra cost, and the sharper the curve, the greater the extra cost for a given length. Engineers have found by experience how much power it takes to haul a train around a given curve. The best information we have on this point is to the effect that one-degree curve increases the resistance by one pound per ton, a two-degree curve by two pounds, and so on in direct proportion.

If an engine is pulling its full train load at a slow speed on a maximum grade, it is evident that on reaching a curve additional resistance is encountered, which is liable to stall the train. It is found that by lowering the grade around any curve which occurs on maximum grade, it is possible to make the resistance sensibly equal, whether on tangent or on curve. Just how much the grade shall be lowered in any case is determined by experience rather than by experiment; that is, when the grade is lowered, it is then observed whether a train picks up or slows down on the curves, and in time it is found how much allowance to make. An allowance which is equivalent to one pound per ton has frequently been adopted as correct, and experiments made on train resistance have been in harmony with this assumption.

If train resistance on a tangent is taken as six pounds per ton, and on curves as one pound per ton extra for a one-degree curve, then the resistance on a six-degree curve will be just double that on a tangent, and in one mile of six-degree curve there will be 317 degrees of curve all told. Just as it requires double the power, or mechanical work, to haul a train over two miles that it does over one mile, in entirely similar fashion it requires double the power to haul a train over a mile of six-degree curve (317 degrees in all) that it does over a mile of tangent. We have seen how to find the increase of cost due to the extra mile of distance, and in a similar way we can find the increase of cost due to 317 degrees of curvature. We found that in doubling the resistance by adding a mile of distance we did not double the cost of a train mile. In a similar way, doubling the resistance by means of 317 degrees of curvature, we do not double the cost of a train mile.

Taking the itemized cost of a train mile as before, and investigating the effect upon each item, we find in this way that it is reasonable to assume that the increased resistance will increase the item of fuel 50 per cent. The item of engine repairs would probably be increased by 67 per cent for this large amount of curvature. Repairs of cars would show about 60 per cent. The wear of rails on a six-degree curve would be more than double that on a tangent, and for this item

it seems proper to allow 150 per cent. It seems hardly necessary here to specify or tabulate all the items, many of which show no increase. Suffice it to say that the total increase of expense due to 317 degrees of curvature will amount to about 30 cents when the average cost of a train mile is $1, or 24 cents when the cost of a train mile is 80 cents. In the latter case the cost of one degree of curvature will be nearly 0.08 cent per train mile, and the annual cost for one train each way 58.4 cents. At five per cent interest, the capitalized sum will be $11.68. That is, on a road where there is one train each way daily, we can afford to spend $11.68 to save only one degree of curvature; that is, to save $\frac{1}{360}$ part of a circle. With ten trains a day, we can spend $116.80, and with 25 trains a day we can safely spend $292, to save even one degree of curvature. In turning a right angle, or 90 degrees, the figures would show for one train a day $1,051.20; for ten trains, $10,512; or for twenty-five trains, $26,280.

Rise and Fall. — There can be little doubt that in passing from one point to another it costs more to haul a train if a succession of summits has to be passed over, than if there is a continuous rise or a continuous fall from one terminus to another. It is perhaps less easy to investigate this matter than the cases of distance and curvature, but reasonably satisfactory conclusions may be reached here. It may readily be shown that it takes about the same power to raise a train vertically 26 feet as to haul it a mile on a level. We then seek to find how much the cost of a train mile will be increased, if the train be raised through a height of 26 feet and then lowered again, or if, in other words, there occur in the mile 26 feet of rise and fall. It will make a difference in the cost whether, in running down hill, brakes need to be used (1) constantly, (2) occasionally, or (3) not at all. Taking the medium case, where steam is occasionally shut off and brakes occasionally set in running down hill; investigating in detail as before, we shall find that for 26 feet of rise and fall we shall increase the cost about $3\frac{3}{4}$ cents when the average cost of a train mile is $1, or about three cents for a train mile cost of 80 cents. The cost of one foot of rise and fall will be $\frac{3}{26}$ cent, and this for one daily train each way will in a year amount to 84 cents, or capitalized at five per cent, we can afford to spend $16.80 to save one foot of rise and fall; $168 for ten trains, and for 25 trains a day we can profitably spend $420 to save only one foot of rise and fall. These figures reached in the case of distance, of curvature, and of rise and fall, may seem large; it must be remembered that they result from a slight increase in the cost of running each train. Anything which would cause an increase in the number of trains would in all probability cause even a greater

yearly expense, and would justify even a larger expenditure if by making it the increase in the number of trains could be avoided.

Maximum Grade. — When you increase the grade on a railroad you increase the resistance or the power required to haul a given train. With an engine of given power, as you increase the rate of grade you must decrease the length of train or the engine will not haul it. With a given traffic to be carried over the line, an increase in the grade means an increase in the number of trains, unless you increase the weight of locomotive, and this in general may be considered out of the question. You are probably using the heaviest locomotive practicable in any case. It will certainly, for our present purpose, be sufficient for us to confine our consideration to the case where an increase of grade means an increase in the number of trains, which may be considered the usual case. How, then, shall we proceed to determine how much we may spend to avoid a given increase in grade?

As in the case of distance we found the increase of expense due to hauling a train over double the distance, and as in our consideration of curvature and rise and fall we considered the increase of cost due to doubling the resistance, in a similar way, in investigating the effect of grade, we proceed to find the increase of cost due to doubling the resistance, but in this case, doubling the resistance by doubling the number of trains. Without here stating the items in detail, it is sufficient to say that an investigation similar to the others is again made in this case, and it is found that the train mile cost for an additional train is about 50 cents when the average on the road is $1, or 40 cents for a train mile cost of 80 cents. Now if we wish to compare two given grades, it is clear that if we know what allowance to make for train resistance, and have given the weight and proportions of the locomotives used, we can without difficulty calculate the weight of train that can be hauled on each of these grades. A comparison of the train weights on the two grades will show by what per cent the number of trains must be increased on the steeper grade in carrying a given traffic. If the increase in the number of trains is 20 per cent, then the increase in cost will be 20 per cent of what we have found as the proper figure for doubling the number of trains. It must be further understood that when you increase the number of trains, each additional train must run over *every mile of the division*, and if the division be 100 miles long, each additional train will cost, using our previous figures, 40 cents for each mile, $40 for the division, and this for each train. It will not be profitable for us to follow out with figures all the steps in this process, but it is evident that the expense of increasing the rate of grade is likely to be very large comparatively; it will be profitable for us to take at least one example, so that we may

know about how much the disadvantage of steeper grades really is, in dollars and cents.

Calculations made for an average consolidation engine show that on an operating division 100 miles long, a difference in grade between 0.70 per 100, or 37 feet per mile, and 1.00 per 100, or 53 feet per mile, for one daily train each way, at 80 cents per train mile, will justify an expenditure of $8,000 per year; capitalizing at five per cent, we find that we may profitably expend $160,000 of capital rather than make the maximum grade of the division 53 feet per mile, if by this expenditure we can keep the grade at 37 feet per mile. For ten daily trains each way we can spend $1,600,000, and for 25 trains per day $4,000,-000, to secure the lower grade. In figuring the number of trains, all trains running should not be included, but only those (mostly freight) whose length would be affected by the difference in grade.

In comparing one line with another, the length, total degrees of curvature, and total rise and fall, are found for each line, and the difference is found for or against one of these lines; the difference in grade is also noted. To the cost of construction for this line are added or subtracted, as the case may be, the allowances for the differences in distance, curvature, grade, and rise and fall. The line which is thus shown to be the cheapest is selected.

No mention has been made of the necessity for locating so as to secure business, simply for the reason that it is not the purpose of this paper to discuss that question, which is perhaps of no less importance than that of operating expense.

The figures shown for grade seem large, and they are large, but the writer believes them to be substantially correct, and they go to prove the proposition stated early in this paper, namely, that the work of the civil engineer in designing work for economical operation is of the highest order of importance. The opportunity for waste is so great that it seems wicked that a considerable portion of the earlier work in railroad location should have been done without proper appreciation of such questions, or sometimes in disregard of them.

It is desirable that attention should be called to the fact that the sum that can profitably be expended in any of these cases depends on the number of trains. It follows, then, logically, that on lines where the traffic is small we shall make the location so that cuts and fills shall be as light as may be, even though the line be longer and more crooked; on a line of large traffic, on the other hand, we shall make the line as straight as practicable, even though the cuts and fills are large. We should do this, however, not blindly, but we should lay the line where we find that first cost and operating expense, both con-

sidered, will give us the most economical line. The figures we have given will further convince us that many earlier lines were properly located for the conditions of the meagre traffic which then existed, but have since become unsuited to the larger traffic in later times carried over their line.

We can understand why it is that many of the older and more important trunk lines can afford to expend enormous sums of money in improvement of line and of grade. It is easy also to appreciate, in the law regulating the abolition of grade crossings, the justice of the provision that no grade of railroad shall be changed except by consent of the directors, or rather, as amended, without the consent of the Railroad Commissioners.

Probably in few places in railroad building is the effect of good work on the one hand, or of inefficient work on the other, felt as strongly as in the matter of location, to which I have called your attention. While the matter of location, then, is a striking instance, it is not the only instance of importance in railroad building. That this is true is instanced by a report of P. H. Dudley, who is well known in railroad circles in connection with valuable work done through the medium of his Dynagraph Car. Following certain experiments on train resistance and certain investigations as to coal consumption, he announced that if the train resistance on the Lake Shore & Michigan Southern Railroad could be reduced one quarter, the saving to the road in operating expense, based on the amount of traffic in 1873, would amount to more than $750,000. That a saving of 25 per cent was then possible for many roads was evinced by the fact that comparing two roads entering Cleveland at that time, one with iron rails and low joints, the other with steel rails well laid and ballasted, a difference in train resistance of as much as 57 per cent was found. The moral to be derived from his statement and showing is that the engineer who figures only upon the comparative cost of heavy and of light rails for a series of years stops far short of his whole duty. The smaller train resistance and corresponding smaller operating expense in favor of the heavier rail is a consideration of definite importance.

In a similar way, but to a minor extent, ties treated by preservative agents find their economy, not alone in longer life directly considered, but in some degree at least to the freedom from disturbance of track for a longer period, and the resulting gain in lower maintenance of way expenses and lower train resistance.

In another direction, too, railroad building with reference to economy in operating is a necessity not by any means fully appre-

ciated. This is in the design or arrangement of yards and stations. Many railroad men assert unequivocally that a well-designed yard in this country is a noteworthy exception. It is no doubt true that yards for sorting trains can be operated very economically by gravity, as in the Edge Hill Yards near Liverpool, Eng., where about 2,500 cars are every night sorted without the use of locomotives. Probably where the sidings are arranged so that switching can be done mainly by "poling," economy also results. Nevertheless, it is believed to be true that neither of these methods is very extensively used in this country, even where the topography is well suited to their use. The writer is not prepared at this time to present any figures for the comparative economy of different methods of switching, but the opinion is confidently advanced that, in the development and improvement of railroads in the near future, the suitable arrangement of yards is a point to which considerable attention should be devoted, and with a view to calling upon the engineer for the exercise of his abilities in securing economy in operating.

In another direction, the design of structures for the handling of coal, opportunity for building with reference to economy in operating is evident. In the proceedings of the Master Mechanics' Association for 1887, the report of a committee shows that the handling of coal by ordinary platform costs twenty cents per ton; by the Kerr or Clifton Chute, about seven cents; while by using a high trestle and hopper bottom cars, the cost may be reduced to four cents a ton. The chute which gives the greatest economy of operation costs the most money. Where a small amount of coal is to be handled, the expensive plant will not be justified; where a large amount of coal is to be handled, it would prove ruinous to pay the higher cost per ton for handling.

It is not the purpose of this paper to multiply examples. It is enough that the principle to be observed should be established. The most important points to which attention should be given are, 1, Location; 2, Track surface; 3, Yards. Beyond these, however, profits in railroading, if there are any, are made up nowadays largely of minor economies. To secure these, railroads must be designed and constructed with careful attention at every step to the securing of economy in operating. So impressed is the writer with the importance of this subject that this paper has been prepared with a twofold object: first, to call again the special attention of the civil engineer to the superior importance of this function of his work; second, to strongly call the attention of railroad men in other departments to the economies which their engineers can and ought to secure them, and to urge them that they should demand from their engineers the exercise of

their abilities in this direction. The writer urges that the civil engineer should be employed because it will be more expensive to operate the road if he be not employed, and the engineer must by his works justify his employment for this purpose. When the millennium is to this extent reached, the civil engineer will by universal accord occupy that post of honor which his real worth will then demand for him.

The PRESIDENT. — I am sure we have all been very much pleased with the paper presented by Professor Allen. It shows that he has given a great deal of thought to the subject, and it will be a valuable addition to our records. Under our general rule, the subject is now open for discussion.

Mr. WILLARD C. TYLER. — Professor Allen has shown us how necessary it is to have competent civil engineers employed in the building of our railroads; but from what I have observed on many roads that I have ridden over I have almost come to the conclusion that they did not employ any. The first idea in constructing a railroad is that it shall be straight and level, that a railroad should be built as the Czar of Russia built his road from St. Petersburg to Moscow. The engineer says, "How shall I build this railroad?" He takes a rule and draws a straight line, and says he will build it on that line. That is the theory, but it is not the practice, at least not the American practice. We are sometimes brought to a point in the construction of roads where the choice seems to lie "between the devil and the deep sea." I am not prepared to say whether I should advocate our being drowned or burned by the adversary.

To build a railroad for true economy of operation, it ought to be straight and level; but if we had waited until that method of construction became practicable, most of our roads would never have been built. If we followed the rule of making them straight and level, the cost of construction would be so great that they could never earn their fixed charges. We have had eighty examples in 1893 of roads which could not earn the interest on their cost, they being now in receivers' hands.

Take the Fitchburg Railroad as the best example of where enormous cost of construction has been endured to avoid excessive cost of operation. The State of Massachusetts made the Hoosac Tunnel, four miles long, in order to avoid the expense of twenty-eight miles of trackage necessary to go round the mountain, thus saving many heavy grades and curves, at great cost of obtaining a gentle grade by the tunnel through the mountain. To have built the remainder of that road with a strict eye to the theory of economy of operation between Fitchburg and Greenfield, instead of following the sinuosities of the river, it should have tunnelled through many of the hills; but that would have

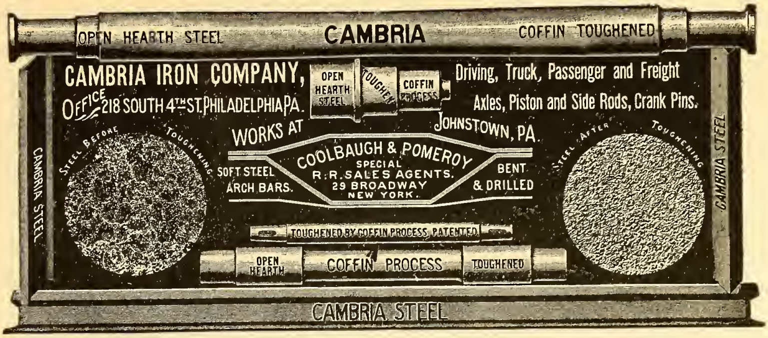
made the original cost of construction altogether too high to earn the interest upon.

Our roads are built without regard to economy of operation. The most familiar example in this vicinity is the New York & New England. This road west of New Britain winds up and down, and finally brings up high above the Hudson River as it approaches Fishkill, and then takes a header down to the river level, and is obliged to run out two or three hundred feet into the stream on piles, and then comes back to the shore, instead of tunnelling through the hills and making a gentle descent from its level, which would have tremendously increased the cost of construction, but done away with an expensive grade to operate upon.

There is another example of a railroad built with much help from the civil engineer, in the New York, Ontario & Western. That road has, about half-way between New York and Oneida, on its line a mountain. Instead of tunnelling through it they formerly got over it with a switch-back railroad. They had four or five levels; they ran up one as steep as they could handle a train on, then backed up the next, then ran up the next one, and then backed up another, and then climbed over the remainder of the mountain. The cost of this operation was enormous, especially in the winter, when it is nearly impossible to back trains up those grades through the snow. They therefore built a tunnel through the mountain about a year ago that cost a very large sum of money, greater than it seemed possible for them to raise for that purpose. Here was a case where enormous construction charges were finally endured to prevent enormous operating expenses.

Another example of a railroad undergoing great construction expenses for which it had no practical use, is the New York Central between Albany and Buffalo. They have four tracks, which look very handsome, to advertise, and they can say that it is the only four-track railroad in the world. The Pennsylvania Railroad between Pittsburgh and New York has only two tracks, and moves on those two tracks twice and one third the amount of tonnage annually which goes over the New York Central with its four tracks. Therefore it would seem that the extra two tracks of the New York Central are largely surplus and maintained at great cost.

There is another class of men who make railroads straight on paper, and these are the general passenger agents. They lay down a line from one end of the road to the other, perfectly straight, and it looks very nice, and in their advertisements they say, "This is our road." They don't even hesitate to move a town from one State to another in order to get it on their line. That is all right in theory, but unfor-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tunately their builders do not carry it out in practice. There is no doubt that the operating expenses of all our roads consume too much of their earnings.

A road to be operated cheaply should have as few curves and grades as possible, and not increase its length of mileage by going round hills when it can go through them. When we can do that we can operate our roads cheaper than we do now. Two things are essential: one is the moving of the rolling-stock over the rails, and the other is to keep the rails in condition to move the rolling-stock over them. The more curves and grades there are the greater will be the cost of maintenance.

Professor Allen has brought out some very valuable figures, and it must have cost him an enormous amount of labor to produce a paper of that kind. His deductions are very valuable, and I am sure his advice is good, that if skilful engineers are employed in railroad building we can operate our railroads much more cheaply than we do now, and a much larger proportion of them would be able to pay dividends.

Mr. John W. Marden. — I have been very much interested in Professor Allen's paper, and I think there are very many lessons which can be drawn from it by all of us. He has tried to show us what can be saved in many ways by the employment of competent civil engineers, and has given us figures to show what can be saved by certain things that can be done by the engineer. He has also touched upon the locomotive and car departments, and I think that in those departments we can get much that is valuable from his suggestions. In fact, if our railroads in all their operating departments would be willing to spend ninety cents and gain a dollar, there would be a very much better opportunity to earn dividends than there is now. In the car and locomotive departments there are thousands of ways in which money can be saved by expenditure in certain directions; and where it can be shown that an interest of perhaps ten per cent can be saved by spending an amount of money that can be hired at five per cent, it seems to me the investment is a good one.

The Fitchburg Railroad has been alluded to by Mr. Tyler. There is no doubt that if the country had been made a little differently we could have had a railroad located which could have been operated much more cheaply; but under the circumstances which exist I don't know as it could be laid out so as to be operated much more cheaply than it is. We have the tunnel, and I don't see how we can very well avoid it. It has been a question whether it would not have been cheaper to have gone over the mountain than through it, but the fact remains that we have it, and what we are trying to do is to make the most money that we can out of the road as it is. The engineers resur-

veyed, if I am correctly informed, the line from Fitchburg through the tunnel, and a great many improvements were made at large expense, — an expense undoubtedly too large, — but a saving has been shown in the expense of laying out. There are many things that come under my observation in the car department where a saving can be made by carrying out a certain line of expenditures, and I think that should be done where it can be done properly. I wish we could have a paper read at one of our meetings that should bear more especially upon the locomotive and car departments, which would give us some statistics with reference to economy in their management.

I think that Professor Allen is entitled to the thanks of our association, and if in order, I move that a vote of thanks be given him for his valuable paper.

The motion was unanimously carried.

The President. — We have with us Mr. Turner, formerly engineer upon the Fitchburg road, and we shall be very much pleased to hear a few words from him upon this subject.

Mr. E. K. Turner. — Mr. President and gentlemen: As the Fitchburg Railroad has been alluded to, it may be interesting to have a little history of that road. It was the Massachusetts Railroad when it was started. At that time money was scarce and difficult to get, and it was hard work to get enough to build a cheap road. It was built and used until about 1875, and at that time its location through the tunnel made it necessary to enlarge its facilities and change the road. For thirty years that road was used. To have put that road in proper shape for a large business when it was built would have increased the expense three millions. In thirty years it would have doubled enough times to give twenty-four millions. In 1875 we went to work to improve the road, getting it ready for new business, and from that time until 1885 about four million dollars were spent to put it into the shape it is now in. I do not mean to say it was necessary to build a cheap road when it was built, but it was thought advisable, and when the proper time came for something else, it was provided. I think, so far as the grades are concerned now on that road, that they have been reduced from 60 and 70 feet grades, coming east, to 47 feet. There were long gradients, and 47 feet was the best we could get, and that we adopted as a ruling grade. There were grades up and down. There was an attempt made to reduce them to single long gradients, and in one case I kept an account of the number of cars handled by a locomotive, and found that this change of gradients resulted in saving about 13 per cent. I think most of the roads in this part of the country were built under the same conditions as the Vermont and Massachusetts. There

was a light business in prospect, the amount of traffic coming was apparent to nobody, it was an unknown quantity, and no equation that I know of would work out the results. It was better that the roads should be built cheaply at that time and afterwards improved. For instance, the Boston & Albany road has been improving for a number of years, and the grades have been changed wherever they could be with that end in view, and I have no doubt that a large saving was effected in that way. There is very little on the general subject that I can say after the instructive and interesting paper which Professor Allen has read.

Mr. W. F. Ellis. — When the State of Massachusetts appropriated $545,000 to finish the Fitchburg road from Greenfield to the Hoosac Tunnel, the road was partly built, and I was at work in the engineer's corps of location and construction from below Charlemont to the Tunnel, and I remember the orders of the chief engineer, Mr. Field, were that the road had got to be finished on that appropriation. The rails were laid and trains were allowed to get to the Deerfield River by our putting in a great many eight-degree reverse curves, especially around Zoar, which was a great disadvantage to the running of the trains. But if the ideas of Mr. Field as a civil engineer could have been carried out, the Hoosac Tunnel road would not have been in existence to-day, because it never could have been finished with the amount of money appropriated. After the State had put the money in and trains were running, the road was turned over to the Fitchburg road, and there was $100,000 expended over the State's money. I bring out this fact to show that in a great many cases the ideas that the engineers had were similar to those that Mr. Allen has put forth to-night. They are not allowed to put them into practice in many cases by the organizers of new roads, and they have got to build the road they are engaged on with the money at the command of the company. To do so more curvature is put in, and in some cases where the roads become bankrupt before they commence running, new engineers come on, as I have myself gone on roads partly finished, and lay them on different grades from what was originally intended, in order to get them finished.

I was much pleased, in listening to Professor Allen's paper, to see that in certain instances, where the amount of money to be used is 100 per cent, he allows one quarter of it to go to the maintenance of the way department, which is the foundation of all. If the foundation is not kept up in good condition, it will be to the disadvantage of the transportation department, and a larger percentage of money will be lost than I think the railroads to-day realize.

Mr. James N. Lauder. — After hearing the able paper presented by

Professor Allen, and realizing the thorough manner in which he has figured the subject, especially in giving statistical information in regard to the cost in detail of operating a railroad, and what could be saved by slight outlays in many cases, by reason of cutting down the grades and somewhat changing the lines, I hesitate about saying anything on this subject. It is such a deep one and so vast that the matter treated in his paper would need to be thought over and digested before one could discuss the propositions that he has brought forward with any degree of satisfaction. There is one thing, however, that occurred to me, that I think might be done at a comparatively small expense, on many of our railroads, that would produce a large measure of economy, and that is providing better facilities for sorting cars. I do not think there are five per cent of the yards in the United States where trains are made up, and cars shifted between the trains and sorted out, that were ever designed with any idea of the service that they were to be put to. It was simply to get land enough, and on this land place a large number of tracks, sufficient to furnish storage capacity for the cars that might come to that particular yard. Now, there is no doubt yards can be designed where the sorting of the cars could be done very much more economically than it can in the usual way. The ordinary way is to hitch on a string of cars and drill them back and forth; perhaps making them into long trains of 40 or 60 cars, and giving as many movements to that entire train as there are cars in the train. This to the mechanical department means something. I assume, and I think my friends here who have charge of the maintenance of cars on our railroads will agree with me, that a very large percentage of the repairs of cars — I am now speaking of freight cars — are brought about by the handling of these cars in the yards, sorting them out and getting them to their proper places, by what is commonly termed switching. In these yards, while this switching is going on, much damage to the cars is done. But if we could have proper yards for this service it would largely reduce the "bad order" car list on every road in the United States, I believe. I hope at some future time that we can prevail upon some of our members, and if necessary go outside and get some civil engineer who is posted in the best modern methods employed in Europe as well as America, to give us a paper, illustrated perhaps with drawings, upon this subject, and show us the proper yard to sort cars in, when they are brought there to be made up into trains or to be placed where they can be unloaded. It would be one of the most interesting subjects that we could listen to, and it should be an exposition by a thoroughly competent man in this matter of switching cars.

I unfortunately had charge of the car department of a railroad for ten years, and I think that I may say that I know something about taking care of freight cars that are broken up in yard switching There are plans of yards in existence to-day, and some in operation, where this switching is done on an entirely different plan from the old method of hitching forty, fifty, or sixty cars together, and drilling that whole train back and forth to get at individual cars. It is one of the important things brought out by this paper, and I trust that we shall have a paper presented to us, showing better methods of handling freight cars in yards at terminal points than now generally prevail.

Mr. Willard C. Tyler. — I am afraid I was misunderstood in my remarks about the Fitchburg road as an example of a road where great initial cost had been endured to effect economy in operation. We are always between the two alternatives of excessive cost of construction for a level road, and excessive cost of operation for one with heavy grades and curves. I took the Fitchburg road as the best example where extraordinary cost had been incurred to reduce the expense of operation. I have no doubt they expended all the money they could raise in building the road between Greenfield and North Adams, and I can easily see there was a very poor outlook for the earnings of that road when it was built. I call to mind another railroad in this country as the best example of high cost construction to secure economy of operation. That is the West Shore. That was built with the intention of handling through freight at the lowest possible cost of operation. We all know its enormous money cost. It went through hills, made deep cuts and low grades. Then at Coeyman's Junction, about fifteen miles south of Albany, it swung off northwest and hit Utica about two and one half miles back of the city, and then went on about twelve miles south of Rochester, necessitating the changing on to another road for passengers to get into that city. It did manage to hit Syracuse on the north edge and run along at the side of the salt pits. Then the money gave out, and it proceeded with a single track to Buffalo, and is a single-track road to this day from Syracuse to Buffalo. That is the best example in this country of building a railroad at low cost of construction and finishing it completely before it was operated. Owing to this high cost, the West Shore has never earned its fixed charges.

I want to mention a fact in connection with the Lake Shore road for the benefit of Mr. Allen, and that is, during the early part of 1893 the grades on that road were all reduced, so that none of them exceeds fifteen feet. That is probably the best example of a straight and level railroad of five hundred miles in this country. I think the operating

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expenses of this current year on the Lake Shore road will be found to be less than on any railroad of its size in the country.

Mr. J. H. Graham. — Isn't the Canada Southern road built straight?

Mr. Tyler. — In reply to that I would say that my remarks applied to railroads in this country, and I am afraid that that road could not be considered as in the United States. The country through which the Canada Southern runs is so level that it could hardly have been built otherwise than straight, and there was no good reason for making it crooked, even if they had wanted to do so.

The President. — We have with us Mr. Sutherland of the Boston, Revere Beach & Lynn Railroad, and we shall be pleased to hear from him.

Mr. R. D. Sutherland. — This subject is too deep for me too undertake to say anything about it, and furthermore I am not sufficiently familiar with the topography of the country to charge the civil engineers with so much guilt as some others are inclined to do. I think if they had been allowed to display their ability more than they have been, in all probability there would have been better results than we have attained.

The President. — We should be glad to hear a word from Mr. Coghlan, of the same railroad.

Mr. John Coghlan. — Mr. President: I have not much to say, because the subject, in which we are all interested, has been covered so well by Professor Allen. In my early days I was connected with some railroad engineers, who were laying out railroad structures on the other side of the Atlantic, and observed some improvements there which might be economically introduced into this country. Their expense was so great that it would have been out of the question in the past, and as to the present system in Europe for the economical handling of railroad cars, Professor Allen and Mr. Lauder have spoken of that. The time may come when such a system may be introduced into this country, for handling freight cars especially, but I am afraid it will not be in our time.

The President. — We have with us a division master mechanic, Mr. Wiggin, and he can probably tell us whether Professor Allen was right or not in his deductions.

Mr. C. E. Wiggin. — I think Mr. Lauder would be better able to speak in regard to the division you refer to than myself, because he had a much longer connection with it, and knows its ins and outs better than I do.

Mr. James N. Lauder. — I entirely agree with Mr. Wiggin. I commenced my railroad service when fourteen years of age on the railroad

which is now the Concord Division of the Boston & Maine, the road with which Mr. Wiggin is now connected. It seems to me I have walked the whole length of that road a hundred times, and I presume I have many times, and I don't envy Mr. Wiggin in operating that northern road in New Hampshire. That was built in the forties, well built and engineered, considering the topography of the country. It is a road with heavy grades and sharp curves, built through a very hard country to lay down a railroad in, and it has played an important part in the development of lines to the West which are running to-day, passing a large Western traffic, perhaps as large as any single-track road of this country ; and it has been operated with great success, and I congratulate Mr. Wiggin on that fact. Now, it seems to me this subject is about exhausted. The fact is that Professor Allen has treated the matter with so much ability there is very little left for us to say and nothing to criticise. All his propositions are so consistent with what is proved by experience and common sense that I can see nothing in what he has advanced to take exception to. I move that the discussion be closed. Motion carried.

At this point the meeting adjourned and repaired to the adjoining room to partake of a lunch.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, Feb. 14, 1894.

PRESIDENT CHAMBERLAIN occupied the chair, and announced as the subject for the next meeting, "Some Incidents of Life in Mexico," a paper prepared by Mr. F. M. Twombly, of the New York, New Haven & Hartford Railroad.

Mr. Lauder moved that the President appoint a committee of three to recommend a list of officers for the ensuing year, to report at the next meeting. Carried. The President appointed as such committee Messrs. Lauder, Marden, and Adams.

The President announced as the subject for discussion for the evening, "Lubrication of the Journals on Rolling Stock, and the Cause of Hot Boxes, and What can be Done to Obviate Them," to be opened by Mr. F. D. Adams, of the Boston & Albany Railroad.

ADDRESS OF MR. ADAMS.

Mr. President, and Gentlemen of the New England Railroad Club,— At the last meeting we were entertained here by a very instructive paper by Prof. Allen. Of course you know very well that I am not able to come before you with any such paper or any such discourse as Prof. Allen gave us. I am not a graduate of any of the schools. I

am simply a workingman. I have had some experience with journal bearings, and I can simply give you my judgment and opinion from some of that experience.

The causes of hot boxes are various. The first, perhaps, would be alluded to as an excessive load. If we get an unusual load upon a certain amount of bearing surface, it is very easily understood by every one that it gives us such an amount of friction as to be absolutely impossible to keep it from heating. If the bearing surface is sufficiently large to meet the demand, and properly lubricated, there is no great difficulty in making it run without. The size of the journal enters into it very largely. In the olden times, as those of us who are somewhat old in the service know very well, the journals were very small to what they are now. They have grown gradually larger. When they arrived at about 3¼ x 5, it was supposed that they had got it abundantly large, and that they would carry all the loads that might be required of them in the most economical way. Those of you who were familiar with the earlier history of the Master Car Builders' Association will recall very well that we had quite a war of words in order to obtain an additional size to our journals. The mechanics through the country were very generally opposed to increasing the size of our journals; and it was with a great deal of difficulty, and required a little shrewdness, to succeed in getting them increased at all. There was quite a fair number who were anxious to increase the size of the journal, but there was so much opposition to it that it was with a great deal of difficulty that any increase was arrived at. Finally, by a sort of compromise, we succeeded in getting adopted by the Master Car Builders' Association the 3¾ x 7 journal, which was an additional amount of bearing surface of some five or six inches to a journal. Some two or three years afterwards this was adopted by the Master Mechanics' Association. The mistake we made at that time was that we did not get them larger. If we had made it larger then, we should have been better off than we were.

Since that time, as you are all aware, there has been an increase of the size, which has made it very much better for the loads we carry at the present time.

Now, while we have a great many of those old cars in existence, the tendency of our freight men, freight agents, and shippers is to load these cars without regard to the size of the journal. The consequence is that very many of them are overloaded and the hot box is no uncommon thing; some of them even so much as to cut or break the journals off by the extreme load that is put on those small journals.

The journal adopted for the present car is very much larger. Four

and a quarter by eight is what is adopted as the standard, and it is very much better adapted to the needs and wants of the present car than the old ones. But while we have so many of our old cars that are still with small journals and liable to be overloaded at all times, we shall continue to have that trouble with hot boxes which we have always had to a greater or less extent. The increase of bearing surface now is more than double what it was on our cars twenty years ago.

Another cause of hot boxes is the bad fitting of the brass. A good many brasses are put in, and used perhaps, that are too rough — not finished as they ought to be — do not properly fit the journal. The consequence, of course, would naturally be that they would get hot before they get worn down to a fit on the bearing.

There is another point that I have noticed myself, and I presume most all other experienced men have noticed in their experience. The style of brass that was adopted by the society at first with the 3¾ x 7 journal — and I believe generally the same style of brass is adopted for the 4¼ x 8 — was an octagon back. I have found in many cases — and this is absolutely certain to make a hot box — that the key was too narrow on the edge; in other words, it would bear upon the edge of the key and not fit upon the back of the brass. In that case it hugs the journal tight. The longer it wears the worse it becomes, because the brass gets a little thin, and it will spring a little, and it will hug it tight, preventing the lubricating matter from flowing in over the journal. The consequence is a hot box invariably. I find that to be the case in very many instances. I found it quite recently in some cases among cars that have come under my observation.

Another source of hot boxes is a very simple thing. It would seem as though anybody would know better than to do it, but still it is done by a great many. That is improper packing. I believe, and I think others will agree with it, that very many journals that run hard are brought into that condition by a continued jamming of waste into them without ever removing it, and packing it so hard into the back part of the boxes that no oil will pass through it at all. It is like wringing a cloth out of oil or water; you can get it so solid and so hard that you cannot get any lubricant through it at all. I believe this is the source of very many hot boxes. The oiler comes along and looks in. It is a little dry. He jams in some waste and turns in a little oil and calls it all right. He thinks he has got plenty of oil, when there is no oil at all except just at the front of his box. The back end of the journal, or the rear part of the box, will be perfectly dry. No oil will get there at all. He will go off supposing it to be all right, and within ten miles it will be as hot as can be. I have found that to be a very frequent occur-

rence. It has been a source of annoyance a great many times to try to impress upon our men sufficiently the fact that they must remove all the waste and clean it out, shake it up, re-oil and re-pack it. That is the only way to obviate that difficulty.

Another cause sometimes occurs, though perhaps not so frequently. Occasionally, by the vibration of the box and the jolting of the car over the line, the box will rise a little off of the journal. Just at that moment it may catch a string of waste and draw it over the top of the journal, and remain there; and that will almost always cause a hot box.

Another thing, and perhaps the principal difficulty in all the trouble with hot boxes, is the liability of dirt and grit and dust to get into the journals. We all, I think, are fully convinced of the crudeness of the old style of dust guard on our old-fashioned boxes. They are liable, in the first place, to be considerably open, and if they are quite tight when they are first put in, they will very soon wear. The lateral motion operates and produces precisely the same result that a pump would, and it is constantly pumping the dust and dirt into the back end of the box. Even if the front is tight, with a good tight cover, you are constantly bringing dirt and grit into the box through the back packing. I think that is indisputable. If the box can be made so as to keep the dirt out absolutely, if it is properly oiled and well fitted, if the load is adapted to the bearing surface, and if the journal is of the proper size, I do not believe there need be a great deal of trouble with hot boxes.

On our freight trains — of course we all understand — the cars are so numerous that it would hardly be expected that an oil man is going to see and open all the boxes that run over our roads. It would require an army of men to do that; and we are not allowed, particularly in these hard times, to employ men enough hardly to meet that necessity. Consequently they are allowed to run till they get hot, most all of them, before they are oiled at all. I am speaking now of freight cars. The result is that the larger proportion of our hot boxes is on freight trains. Passenger trains are entirely different. They are looked after. They are supposed to be kept in such condition that they will run from one terminus to another without any delay. The roads generally accomplish this, but with all the care that we may bestow upon them more or less of them get hot.

In this connection I would like to allude to some remarks that I saw in the report of the Western Railway Club, from Mr. Waite, of the Lake Shore road. I think, if I am not mistaken, that he reported that they had on that line of road, in their passenger equipment, 54, and an average of 1,100 and some odd hot boxes a month on freight.

I suppose they were not all red hot, but warm enough to be called hot boxes. It seemed to me that that was an enormous amount. I may be mistaken about it, but I think I am correct. I then took a little pains to make some comparisons with our own cars. Of course that would depend largely upon the mileage that was made. I ascertained that they were making about double the mileage in their passenger trains that we were. That would subject us to the necessity of having, in the same proportion, 27 or more hot boxes. I took pains to look over the record of the hot boxes that we had on the Boston & Albany road for a year. They are supposed to give a report of all of them that are hot; and all the boxes that were reported on the Boston & Albany cars for a year were 25, — two a month. It compared, I thought, very favorably with the Lake Shore report.

The matter of oil I did not go into, to examine exactly how that compared. In fact, I hardly know how anybody can find out very definitely about the amount of oil used in boxes, etc., with any definiteness as to mileage, because mileage is not kept on freight trains at all. I do not know of anybody that does.

Now I am going to allude to a meeting we had here some time ago when we had this matter up for discussion. It was two or three years ago, or something like that. Brother Lauder had made some rather elaborate tests as to the wear of journal brasses, some very careful experiments, and he came forward here with the statement, if I remember right, — and if I am wrong Brother Lauder will correct me, — that 1,200 miles was considered a good wear for an ounce of brass. I had had no such experience, because I had not thought of the idea in that way, and had not taken any pains to test the matter or look into it in that form. It excited my curiosity a little, and when I went back home I made some examinations. I weighed 100 brasses, and took the average of the 100 for the weight the brass is supposed to be in the first place, which I thought was fair. Then I weighed quite a good many brasses that I had taken out, where I knew what the mileage was, and I found we were making about 3,000 miles to the ounce, which was more than double. Now I am not prepared at all to dispute Brother Lauder's position. If he found 1,200 miles to the ounce the amount of wear for his brass, and if he was satisfied with that, why, I ought not to find any fault; but we were not satisfied with it.

Since that I have taken a good deal of pains to keep the mileage of our brasses, and I have examined the thing pretty thoroughly. We are making on an average, for our passenger trains, not far from 3,500 miles to the ounce of wear. That is about the average amount of brass worn off on our passenger trains. I did not look after the freight in

that matter because it is very difficult to keep track of. In the case of passenger trains we can tell, without any difficulty at all, the number of miles they make, the number of ounces they wear off, and the number of hot boxes we have. I mention this not to blow my own horn at all: I simply state it as a matter of fact; and if the experience that we have had in the matter is of any benefit to those that listen, why, it may accomplish a good end.

I have brought here, for a sample, some brasses that I would like to have all the mechanics look at. The mileage is marked on the brass. I have a brass on which the lead is not worn out that has run 75,000 miles. Another one that ran on the same end of the axle has worn off just 16 ounces. Another one that ran on the other end of the axle is worn more, though of course it made the same number of miles. It wore off 22 ounces. The brasses are different makes. Another brass that has made 194,000 miles is not more than half worn out. In other words, it will make 40,000 or 50,000 miles more easy enough. The average wear of our brasses in passenger trains is about 145,000 miles. It does not vary much from that.

I took a good deal of pains to find out the exact number of hot boxes reported on our road, both freight and passenger, this last year. I went over the whole report, and I found we had 546. I won't say that there might not have been other boxes that were hot that were not reported; but the order stands that they shall report them all to me, and it would be supposed that they would obey the order tolerably well. Of that number eighty-two were on passenger trains, and they were made up in this way. Twenty-five of them were on our own coaches. Twenty-five of them were on the Wagner sleepers. Of course you all understand there are but few Wagner sleepers compared with the coaches that run on our road. The balance, thirty-two, were on New York & New Haven cars that run over our road. The average miles run to each hot box would be 480,000 miles. Excuse me for speaking of our road, but I have no experience with any other road.

Now, as I told you in the first place, I did not purpose to make an elaborate address or anything of that kind. I have only simply stated a few facts and given a few of the reasons that I thought were the occasion of hot boxes. I have not said much about how to remedy them. The best way, in my judgment, to remedy hot boxes, would be to have, in the first place, a good, serviceable, tight oil box. Use any one you please, only make it tight, and make it tight at the back end. It is an easy matter to make a tight box on the front end, but the question is to make it tight around the journal. Make it tight around the back

end, and you will have a box that won't get dirt into it, the brass will wear twice as long, you will have a good many less hot boxes, and a great deal less difficulty in running a train.

The next thing is to use a reasonably good oil, and have them properly packed with a good quality of waste. I am not much in favor of these new lubricators, patent fixtures, springs, and all that kind of thing. I never found anything in my experience, and I have tried a good many of them, that amounted to much. My experience has ways been that the best way was to pack them with good waste and put in plenty of good oil, enough to keep it there; not have it running out the back end or open at the front, the cover off, the dirt flying in, and the lateral movement of the journals pumping it in at the back side. The result is that you get a great deal of sharp grit, particularly in running over a road like that on Cape Cod, where Mr. Lauder's cars run, which is a great difficulty to overcome. If the road is dry, dirty, sandy, you are going to get a good deal more of that in, and your brasses consequently are going to wear much less, and you are a great deal more liable to hot boxes. So far as our line is concerned, we are somewhat favored in that way. It is not subject to that difficulty, as many other roads are, consequently we probably can make a better showing than some other roads that labor under those disadvantages.

The President. — The question is now open for discussion, gentlemen. I understand Mr. Medway had a hot box on his tender at one time. Probably he can tell us about it.

Mr. John Medway. — Mr. President, I don't think I have much to say in regard to hot boxes. I think a locomotive is something like a car in these respects. I believe in regular and systematic packing, at regular intervals. We have practised that with very good results. I do not think I have anything further to say in this respect.

Mr. James N. Lauder. — Mr. President, I was really in hopes to-night that somebody would do some talking besides Mr. Adams and myself. Of course Mr. Adams was selected to open this discussion in view of his well-known ability in that direction, and by reason of his selection he was obliged to get up and say something. The case is different with me; I have gotten up of my own accord. I did not get up, however, expecting to enlighten the New England Railroad Club particularly on this question, because it is a question of such vast proportions, and the causes that produce hot journals, or hot boxes, so-called, are so various that it would take a long while to go into all the different causes and give a connected and systematic account of the results produced by these different causes.

To my mind there are three or four leading causes for journals run-

ning warm under our rolling stock. The first and most important one, I think, is getting foreign matter into the box; in other words, getting dust and dirt into the box, so that an undue abrasion takes place by reason of sand and other foreign matter getting in between the journal and brass and producing an undue friction that sooner or later will produce heat. I believe with Mr. Adams — although he didn't come out very broadly in that direction, yet I think I know what his feeling is — that a dust guard that will absolutely prevent dust from getting into the box will cause more freedom from the annoyance and delays caused by hot boxes than any other one thing you can do. It is one of the most difficult matters that I know of, in the planning and construction and keeping in repair of railway rolling stock, to eliminate this trouble.

Take it in the matter of car journals: there have been a great many plans proposed for so-called dust guards; but to-day I suppose that almost all the cars running over the railways of this country are running with the old-fashioned dust guard of forty years ago. Mr. Adams, as I presume most of you know, has designed, and I believe patented, a dust guard. I do not understand that he claims anything particular for his box, except that he has appliances for the exclusion of dust. I know from my own experience that this is a very important matter in prolonging the life of the journal and the brass, as well as preventing what is known as hot boxes. My experiments with the so-called Bemis box have confirmed me in that opinion. I have no figures to present, but I can give one illustration.

A set of axles was put under a car, the journals being fitted with the Bemis box. Above everything else to commend the Bemis box is its arrangement for excluding dust. It does perfectly. Mr. Adams's, I presume, does it equally as well. In one particular case that was brought to my attention, a car running through the "wilds" of Cape Cod wore out four pairs of wheels with one axle; and after having worn out four pairs of chilled wheels, going at least 200,000 miles, three of the journals out of the eight had lost in their diameter less than $\frac{1}{64}$ of an inch. Now, with the ordinary Master Car Builders' standard $3\frac{3}{4}$ x 7 journal, with the Master Car Builders' standard brass and appliances, on Cape Cod, I have removed wheels from under the car because the journals were worn out before they had worn out one pair of wheels. This shows the difference in the wear of the journal between a box that does not exclude the dust thoroughly and one that does. I am not prepared, because I have not the data with me, to make any definite statement in regard to how much longer the Bemis box would wear than the other. Whatever length of wear it made beyond the other one

was entirely due, in my judgment, to the exclusion of the dust, and nothing else.

The next feature in importance, in my judgment, is the size of the journals. I well remember the contest that Mr. Adams and I and a few others fought to get larger journal in the Master Car Builders' Association. Mr. Adams, in common with a few of the members, — and I have always felt proud of the fact that I was one of them, — believed in those early days in having a large journal, and stuck with a good deal of tenacity for a 4 x 8 journal. This was thought at that time, some twenty years ago, to be beyond question too large. There were all sorts of objections brought up to it. The one which was talked about the most, and of course was, as usual, the most nonsensical, was that the trains would haul hard. Some of us contended that the reverse was the fact. I still believe the reverse was the fact, and to-day I find that a train will haul easier with the 4¼ journal than it will with an old-fashioned 3¼, the loads being the same.

As we began to interchange cars with other roads, getting an absolute standard was of more importance, or thought to be, than getting the proper size of journal, or the best size of journal; and the adoption of the 3¾ x 7 was a compromise between those who wanted a 4 x 8, and those who believed that a 3½ x 6 was ample. We found that we could not get the 4 x 8, and therefore we proposed a compromise, and that is how we came to get the odd diameter, and, to a certain extent, the odd length of 3¾ x 7. That is just half-way between 3½ and 4, and 6 and 8. That is the history of the 3¾ x 7 journal, which was and is known as the Master Car Builders' journal. That journal has done wonderfully good service. It did wonderfully good service until we got our weights beyond its capacity to sustain them. Then we began to have a lot of trouble with hot boxes; and as our weights increased, both passenger and freight, the difficulty increased, until the nuisance of hot boxes, and delays in consequence, became unbearable.

Then, some years ago, the Master Car Builders' Association took the matter up again, and approached it in a very much more liberal spirit, and the new Master Car Builders' journal was adopted. That journal is 4¼ x 8. It ought to have been 4½. I am satisfied that 4½ x 8 would have been a much better journal and would have done better work, and would have remained a standard much longer than the 4¼ x 8 will. Before many years 4¼ will be found to be too small.

I had an experience bearing upon this question of large journals, with a locomotive. About a year ago, realizing that faster time and

heavier trains were in the near future, I designed, and built from those designs, one locomotive for heavy work and high speeds. The locomotive was considerably heavier than anything we had attempted before, weighing, equipped with water, about fifty-eight tons. This is not a remarkably heavy engine, as there are many engines running to-day that go up as high as sixty-five tons for regular fast express work. This was the weight without the tender. This being an ordinary eight-wheel engine, and the larger proportion of the weight having to be carried by four journals, I put in perhaps an abnormally large driving-wheel journal. It was nine inches in diameter. Eight inches is thought to be good size. Eight inches I have used for a great many years, but the journals on these driving-axles are nine inches. That engine runs in fast service with less difficulty in the matter of heating the driving-boxes than any engine we own, notwithstanding she weighs some eight or nine tons more than the ordinary standard engine. This shows very plainly that the large journal must be used if you expect to run without the annoyance of hot boxes.

I find it is exactly the same with crank-pins on locomotives. I found that out, fortunately, some years ago; and my practice for a great many years now has been to put in what would be considered by some unnecessarily large bearings for the back end of the connecting rods.

There is one curious thing, however, that I have noticed. Possibly some of my hearers will not agree with me in this. I have noticed it to that extent that I believe it is true, — that lengthening the journal, while it increases the bearing surface, does not have the effect of preventing heating that enlarging it in its diameter does. For this I can give no good reason, but I am thoroughly convinced that that is the fact. I would rather enlarge the diameter of a pin or a journal of any kind that is liable to heat than to lengthen it. If driving-rod journals are lengthened, I do not think they run any better; but increase it in diameter and a noticeable increase in wearing capacity will be found at once, and freedom from hot boxes will be very much increased.

The third cause of hot boxes — that is, the cause that I consider third in importance — is the quality of the lubricant, especially with journals that cannot be protected from the dust, like driving-axle journals and locomotive crank-pins. That this dust is a prolific cause of disaster to the locomotive is plainly seen when engines are run in the way we call "double head"; that is, two engines hitched to one train. The forward engine rarely heats or gives us any trouble; the rear engine is almost invariably hot. This, of course, is caused by the front engine kicking up a dust, and the rear engine gets the dust, there

being no way to protect the journals from the flying dust that the front engine has caused. The only remedy for this is to use oil freely. With reference to the quality of the lubricant, I do not think it makes so much difference in a car box where packing can be used and where dust can be excluded, but in exposed places it is all-important that good, heavy lubricating material should be used. If it is not, it is almost impossible to run without the annoyance of heated journals. This I have found by observation in a great many years of practice, and I believe that it is true. While the figures might show, in comparative tables made for the purpose, that the cheap oil was doing the work for less money, the increased wear of journals and boxes is not, and in the nature of things cannot, at all times be taken into the account. If it could be, there is no question in my mind but what the results given by the better lubricant would justify its use in all cases on a locomotive.

The question of the material for journals also enters into this matter. Some maintain that steel is the proper material for axles, and they cite the fact that it is a perfectly homogeneous material and is always free from seams and other imperfections, and consequently will wear longer and with less liability to heat. That I believe to be true. We are troubled a great deal, when we use iron axles, with the small seams that develop. These are produced when the axle is manufactured by reason of slag or other things getting into the pile and preventing a perfect weld. When the journal is turning it is impossible almost to discover these little seams. After a journal has been run a little and been heated and given trouble, take it out and examine it, and you will find perhaps a seam an inch long, — the little fellow that has been doing all the trouble. I have found these little seams in the crank-pins. Keep it swimming in oil and still it will warm. To cure it, we have taken an iron chisel and chipped a little groove, taken that little seam out, carefully tinning it over and filling it with Babbitt metal, and then smoothed it off and the thing was cured; showing conclusively that the difficulty was entirely with that little seam in the surface of the pin.

Now, with steel you get over that difficulty, but you run into another one. Steel is so fine in its texture, so fine in its physical make-up, that apparently it does not lubricate as well as the iron. My observation is that steel axes, or a steel crank-pin, will heat quicker than an iron one, provided the iron one is freed from these defects that I have described. I have heard reasons given for that which I cannot vouch for. Generally the reason I have heard given by scientific men and by so-called practical men is, that the material of which the steel pin

is made is so much finer that the little cells in it are so small that they won't hold the lubricating material, while with the iron these cells are very much larger, and consequently hold the lubricating material in all these innumerable little cells, and the consequence is better lubrication.

To back up that theory, perhaps it might be well to suggest a glass journal. Glass has no cells as far as we are able to see. It is a perfectly solid mass. Now, everybody knows we couldn't run a glass journal. You cannot lubricate it. It will heat. Why does it heat? It is hard and it is smooth, and it can be made perfectly cylindrical and well fitted. Why won't it run? I believe it is because you cannot lubricate it. However, the material of which glass is made may have something to do with it. I am not going into any fine-spun theories there, because I don't know anything about it. But this question of the material for journals is still an open one. A great many of the best mechanics we have prefer iron. On the other hand, probably a large majority of the best railroad mechanics we have prefer steel. They are both good material, and will both do excellent service if they are made large enough.

Mr. Adams. — I want to differ a little with Brother Lauder on the question of the lengthening of the journal. It is an established fact, I believe, that nobody pretends to deny, that rolling friction is caused by weight almost entirely. Now, if that weight is brought upon a certain number of square inches, it may get hot. Increase that number of square inches to a sufficient surface to meet the demand of the load, and the difficulty is obviated. Now, I believe that the lengthened journal has just as much to do with it as it does if you increase the diameter, while if you lengthen the journal and do not increase the diameter you weaken your journal. That I believe to be clear to anybody. You get it long enough and put weight on it, and it will break off. So that the length and the diameter both want to be increased to keep up a proper proportion, it strikes me. If the weight is the same, and the journal four inches long, you make the journal six inches long; and if the bearing is perfectly good it will run true. I have had just such an experience as that on shafting. A railroad journal might be different somewhat, but it would depend entirely upon the manner in which the weight was brought upon it. If it was an old-fashioned brass, what we termed a saddle-back, and the load was brought in the centre of that brass, it might spring so that the outer end did not get a proper amount of weight. But if the brass had a bearing the whole length properly, and the diameter was not increased, it would relieve the trouble. There isn't much question about that. If it is a fact

which I believe is indisputable, that weight causes friction, if it is distributed over a larger surface, it is a good deal less per square inch, and consequently it would not heat.

In our old journals, 3¼ x 5½, which was the universal size twenty years ago, there were about sixteen or seventeen square inches of bearing surface; in the 3¾ x 7, some twenty-four or twenty-five square inches of bearing surface; in the 4¼ x 8 there are something like thirty-two inches of bearing surface. So you see it is nearly double what it used to be, to accomplish the carrying of the present loads.

I want to say in connection with this, that I never fell in with the 4¼ x 8 journal, for two or three reasons. The Association has voted to make that a standard, but previous to this being made a standard, some two years before, we had come to the firm conclusion that it was necessary to make a bigger journal than we had. Our loads were increasing all the time; and in connection with this box that Mr. Lauder has alluded to that I produced, I, at the same time, increased the size of the journal. For the sake of economy as well as proportion, I took the same length of axle that was adopted as the M. C. B. standard, but I increased the size of my journal diameter up to 4½ inches, turning the button off and using a step in the end of my box to prevent the lateral motion, and did away with the collar mainly; entirely so on the outer end. That gave us an abundance of bearing surface.

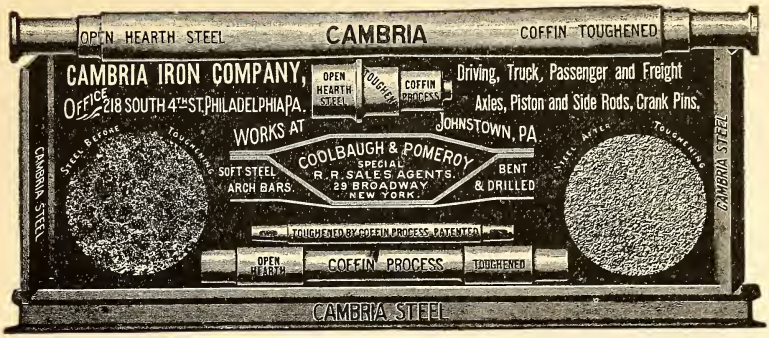
We found by experience that the M. C. B. standard did spring under a good many loads, — the 3¾ x 7. That was demonstrated beyond all possible doubt. You could see it without any difficulty. Consequently that axle would move on a cam all the time, which increased the friction a very large per cent. Now, then, that difficulty must certainly be obviated if you are going to run an axle cool. You have got to have a stiff journal, — a journal that won't change its position, and will always revolve truly. Then you obviate the difficulty that occurs from a cam motion. I believe that when changes are made, improvements, etc., you should endeavor in all cases to make these changes with as little expense as you can to the companies. I had that in view when I designed this new box and journal. I kept the length the same as the old one. I made a box that would take the M. C. B. brass just the same as it did before. It goes into the same M. C. B. pedestal that it did before; and at the same time by the simple changing of the brass I can put a 4½ journal into that same box, and do it all the time. We have about two thousand cars running with this 4½ journal; and I think I can say with truth, and without much fear of contradiction, that it is a rare thing that we get a hot box on any of those cars. The reason of it is plain to me. The dust is kept out.

The bearing surface is sufficient to meet the load. There is no spring to the axle, and the consequence is they run smoothly, without any difficulty.

I want to refer to another point which may be interesting. Perhaps you will not all agree with me on this, but I think it is an important point to all railroad men, particularly those in charge of the mechanical departments. I have found by experience that when a journal does get red hot, which is no very uncommon thing for them to do, if you dash a pail of cold water on to it it will invariably fracture the journal, and it will break off sooner or later just as sure as you run it. We have had some experience in that line. We have found axles that, after being run a little while and being taken out for examination under a glass, were found to be fractured clear around next to the back collar. That was caused undoubtedly by just that process. It has resulted on this entire line of road so that we have a positive order issued by our general manager that they shall in no case dash cold water on a red-hot journal. Set it out on a siding if it is so you cannot run it, and let it be until it cools. I think that that is very important, and something that every mechanic should understand. We do not want to rout the people out of a sleeping-car, for instance. It is a very unpleasant thing to do. But it is far better to do it than it is to dash cold water on the journal and fracture it, and run the next fifty miles and break it off and wreck the train.

I don't know that I shall be telling tales out of school if I tell one circumstance that occurred to a very fast train that came into its terminus at one time with one of those journals broken off, and the passengers did not know it. If they had, they wouldn't have wanted to have ridden on it, but I believe it is a fact. I have been told so, and I guess it is the truth. I consider that a very dangerous operation to any car on a passenger train, and also dangerous on a freight train, because if you break an axle you may wreck your whole train and destroy thousands of dollars worth of property which might be saved by simply setting that car out on a siding and leaving it.

Mr. Lauder. — If you will bear with me a moment, I would like to say a word in reply to some of Mr. Adams's theories. Now, as to this question of water on hot boxes, I don't take any stock in what he says about it. In the first place, I don't think that is what breaks the journal. I think the journal is cracked by running when it is hot, with an immense weight on it. Any mechanic knows, and those that are not mechanics can see, that a journal that is run till it is red hot, with such an immense weight on it as this, must necessarily spring badly, and that is what carries a little fracture all around. He is right when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he says the journal is fractured clear around sometimes. To dash cold water on it, with the weight that is on that journal, I don't know as it would produce a fracture, and I don't know but it would; but I don't think it would be a wise thing to do. If the box is jacked up so as to take the weight off the journal, I can see no earthly reason why cooling the journal off with cold water should harm it, providing it is not already cracked. That is the way I have always looked at it. It never has been my practice to run a journal that has been red hot. I take them out, no matter whether they look well or not.

Mr. Adams. — Let me ask a question. Doesn't the axle expand some when it is heated?

Mr. Lauder. — Yes.

Mr. Adams. — Won't it contract suddenly when it is cooled quickly?

Mr. Lauder. — Yes.

Mr. Adams. — Won't that produce a fracture?

Mr. Lauder. — No. If it did, every time a blacksmith plunges a piece of iron into cold water, which they are doing all the time, it would fracture it. But we know that it does not. I am aware that in some cases there are some tools which will fracture and which have to be cooled in oil, because the sudden contraction will crack the material; but it usually cracks lengthwise instead of across its diameter, although I do not think that is universal. But to cool off a journal by dashing water on it, the cooling is necessarily so slow that it cannot produce contraction sufficiently rapid, it seems to me, to cause a fracture. Whenever, as I said before, a fracture is produced, I believe it is produced by the revolving of that journal when it has got so hot that it is so weakened that it must spring down. It rolls over and springs down and produces a fracture all the way around the journal. The fracture that is produced such as Mr. Adams describes, I think he will agree with me, is usually in the end of the journal that is next the wheel.

Mr. Adams. — It is next the back usually.

Mr. Lauder. — Why is it there?

Mr. Adams — I admit your argument, and stand corrected. It is quite possible that it is weight that does it. I know it is done.

Mr. Lauder. — I would like to say here, and I would like to impress upon the younger and rising generation, that it is dangerous in my judgment, and that judgment is drawn from observation and many years' experience, to run a journal that has been anywhere near red hot. A journal that has been red hot should be removed at the earliest possible moment, to avoid disaster.

With reference to the size of the journal, I do not propose to get into any controversy with my friend Adams, because I agree with him

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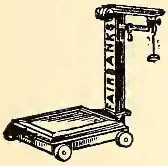

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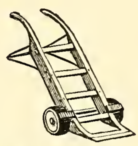

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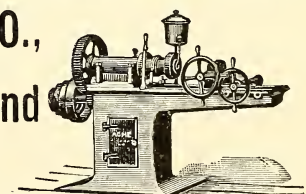

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largely in what he says. Friction is produced by the weight carried, largely. If there was no weight, there would be very little friction.

That goes without saying. But he speaks of the proper proportion between length and diameter. I would like to know who there is to-day in this broad world that is prepared to say what the proper proportion is. I am free to say that I do not know, and I do not believe there is any other man that knows, the conditions which largely determine that fact. If the journal is made large enough so that it won't spring, either between the wheels — and that is a very important matter — or the journal itself, possibly lengthening the journal and increasing the bearing surface in that way would have a good effect. But, unfortunately, our journals do spring between the wheels, under the enormous weight placed upon the journals; and it would be almost impossible, at least impracticable, to get axles of sufficient size between the wheels to prevent some springing. The moment that springing takes place the outer end of the journal droops, and consequently brings a larger percentage of the weight on the end of the journal next the wheel. That fact undoubtedly produces a great many hot boxes.

Now, the large journal must be supplemented with a large axle. The axle should be large between the wheels, as well as having a large bearing surface, in order to have the box run without heating, and run properly and carry the load safely. I have serious doubts about its being proper to reduce the axle in the centre, as is almost universally done. I do it myself, but I am not certain but what it is bad practice, because it produces just this state of things which we are crying out against.

There is a good deal to this question of lubrication. My friend Brady here would claim, of course, that the Fox truck is all that is necessary to make a journal run without heating. Well, perhaps in a measure he is right. The Fox truck is got up with templates and presses and everything in good shape. I am willing to give him the benefit of a little advertising "free gratis." A hot journal in a Fox truck is something that I have never yet seen, and I have never found a man that has seen it. It isn't all the Fox truck, however, although I think it is partly due to that. It is largely due to the fact that that Fox truck always has a big journal. It not only has a large axle which prevents undue springing between the wheels, but it has large journals, the bearing surfaces are large, and the result is that the Fox truck gets the benefit of the fact that there are no hot boxes, when it doesn't really belong to the truck. This question of truck under freight cars has a broad bearing on the question of hot boxes. A truck that is thrown together and put under a car, costing about $375 when it ought

to cost $550, of course is a very crude affair, and after it has run a little while it is all knocked out of shape. Under such conditions you could not expect the thing to run without getting hot and being a nuisance. But so long as railroads will buy cheap cars and cheap, old-fashioned trucks, because they can buy them for less money than they can buy a good thing, they must necessarily bother Brother Adams when he gets them on to his road, heavily loaded, coming down the mountain.

The President. — We have with us to-night a gentleman with whom I am not acquainted, but it is said that he has had experience in the subject under discussion, and we should be pleased to have him make a few remarks,— Prof. Leonard Waldo of Bridgeport.

Mr. Waldo. — I came over from New York this morning to hear the discussion, which I have listened to with a great deal of attention. I do not know that I have any particular claim upon your attention, further than that as engineers we have done considerable in regard to bearing surfaces, both for the Government, and I think one of our contracts was in designing bearings for the engine which would haul the "flyer" between New York and Boston. I will further say that we have made quite a careful study of lubricants in connection with bearings, because it seemed to us that the question was not either a mechanical or physical question wholly, but was also a chemical question. In looking up the literature on the subject, we found that a certain man, Mr. Isaac Babbitt, had received a gold medal from the Massachusetts Mechanics' Charitable Association in 1841, and that the ground for the award of that medal, and the subsequent grant from Congress of $20,000, was expressed in the letter from the master mechanic of the Boston & Providence Railroad Company, which was written from Roxbury in September, 1841. In this letter he says that for fourteen months a box of Mr. Babbitt's description has been used continually, and has travelled nearly 31,000 miles. He cannot see that the box has received the slightest injury. They require one half the usual quantity of oil and very little attention, and are at least 75 per cent cheaper than any he has ever used before.

If you follow the history of this distinguished inventor, you would know that subsequently he received a grant of $20,000 from Congress in consideration of his having done a great thing for mankind.

Referring to the lining which Mr. Adams referred to, which he said was lead, — we will assume that at least it had the merit of being lead, — if you put an ordinary lubricant on it, the ordinary lubricant generally contains an acid or something or other which will have a reactionary effect upon this bearing. A surface is at once raised which is hardened and hammered, the dust is pulverized through it, and you

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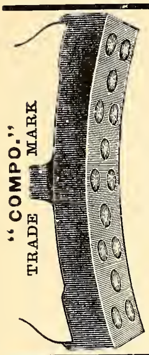

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have a condition existing between the surfaces which immediately generates heat. You must keep constantly in mind that heat is a question of frictional surfaces. The amount of friction in a box has nothing whatever to do with the area of the surfaces; that merely indicates the distribution of this friction. Unfortunately, people who buy these bearings for cars ask "What is the price?" And inasmuch as metals which have high resisting compression strain and good frictional qualities at the same time are high priced, they prefer the increased amount of metal used to shorten the life of the metal, and go directly away from the practice of Mr. Isaac Babbitt, and make their journals large so they can use a poor material for bearing surfaces. I suppose ultimately sand paper will be used, because that is cheaper yet. You are going directly away from good practice, and simply looking in the direction of the first cost.

I came over to-day on the "flyer," and we were stopped eight minutes at New London with a hot box. I walked back and found the customary ring of red on a wheel under the drawing-room car. I was standing in the New Haven station some months ago and a train of some five or six cars came in, and they were held there half an hour while they took out a hot box. I gave the workman who was taking it out a quarter, and he kindly cut off a piece of the corner of the box. I took it to our laboratory, and of course I found it was lead, the usual thing to find in those cases.

It is possible to get rid of your heating, it is possible to lessen your friction, and it is possible to run a box cool; but it can only be done by having a proper appreciation of the mechanical facts which exist in the box, and by having a lubricant which is not constantly dissolving off a part of the box and is not altering the surface. What I believe in regard to the subject of lead and the action of acid is, that the surface run becomes fatigued, changes its character, becomes gritty from the dust and all that sort of thing, and your box is perfectly useless so far as resisting any friction is concerned.

So much for the soft bearings. In regard to hard bearings, if you remember the papers that Mr. Dudley published in the Franklin Institute proceedings, you know he announced something as remarkable as Mr. Babbitt's announcement. Dudley found, by using phosphor bronze, that the phosphor bronze was something like cast iron. He could use a lubricant which would fill up the pores, and this lubricant would be held in suspension, and he got a very good bearing metal. If you look through the specifications for bearing metals on the Pennsylvania road, you will find that the base of that metal is phosphor bronze. It is phosphor bronze of quite high quality, containing ten per cent of tin. But they also call for nine per cent of lead right

in that phosphor bronze. But the lead is there *sui generis*, in mechanical suspension, held in that framework. It is like a sponge dipped in water. The lead is held there and acts as a lubricant. Instead of being there to the amount of ninety per cent, it is only nine per cent, and you get a phosphor bronze bearing, holding the lead in suspension ready to be dissipated as a lubricant, and you get no friction.

The remarks of one gentleman were very pertinent as to the use of steel and iron. Cast iron is undoubtedly one of the very best bearing metals known, and for this reason: It is not acted on chemically; it is not changed by the hammering of the axle into a new form, and it is porous enough to hold a good lubricant in suspension. Therefore, it is a very good bearing metal indeed. But the best bearing metals known are the phosphor bronzes, these in which lead is held in mechanical suspension in the way I have described.

I was told the other day that it was impossible to buy genuine Babbitt metal. I went to the Baldwin Locomotive Works, with whom we had some professional relations, and asked them where they got genuine Babbitt. They said it could not be bought; it had to be made according to specification. I sent out and bought forty samples of metal marked "Genuine Babbitt." It was bought in every part of the country from New Orleans to Portland. Of the entire forty there was one single sample which, by a stretch of courtesy, could be called genuine Babbitt; I mean that described by Isaac Babbitt in 1839. I will therefore venture the opinion that the mechanical builders of this country are not familiar with genuine Babbitt. There are some men who have the skill to make genuine Babbitt, and who use it; but they are very few, because the making of good Babbit metal is a very difficult thing, much more difficult than is commonly supposed. But if you put in the boxes under your trains a Babbitt metal which does not contain the weakening influence of lead at all, the full amount of block tin of the best quality, only antimony enough to harden it, you get a metal, first, that no amount of hammering will heat, and, second, which the ordinary acids of lubricating oils will not affect; and the truck will run and keep perfectly cool. I may be a little strong and a little enthusiastic in these statements, but I can assure you they are based on a series of very careful experiments, made with the finest testing apparatus that could be procured.

Mr. James H. Graham. — Can you give a formula for a composition that some railroad companies seem to want, to cost 11 cents a pound, to put into a thirty-ton freight car?

Mr. Waldo. — Well, their name is legion.

Mr. Graham. — What would you recommend?

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Mr. Waldo. — Well, I really fail to see the economy of using metals which cannot be melted, which are dross, and which simply take extra work to run them and give uncertain results. I am not inclined to advise anything but the best so far as I am concerned personally. An engineer who ought to have known a great deal better came to me and said he wanted a metal at seven cents a pound. I said that metal would be good for overhead shafting in saw mills, and that was about the best he could expect of it. Mr. Isaac Babbitt himself, in his original patent, used fifty parts of tin, five of antimony, and one of copper. Of course the very great disadvantage of introducing any lead whatever in a soft bearing is the fact that the metal itself has no compression strain to speak of; and that is why these gentlemen spoke of increasing the size of their bearings. Of course I am not considering now the strain on the axles. That is another question althogether. They will have to increase that, because, with the tremendous loads per square inch put on the small bearing, the cheap bearing won't stand.

Mr. Graham. — Well, but they do stand.

Mr. Waldo. — Yes, but they have got the large axles.

Mr. Adams. — I was going to ask a question of the gentleman in regard to this lead. I was very much interested in what he said. It is possible that we have all been making a sad mistake in using lead bearings. The theory of most of the railroad mechanics at the present time is that a bearing lined with lead makes it somewhat self-adjusting. That was probably the original object of lining with lead, to make a self-adjusting brass. Almost everybody understands that journals are not always true. They are out of line, they are either concave, or some other way. Now, if you put a hard bearing in, — a phosphor bronze, or one of that kind, — it bears only at the ends, a small part of the bearing surface. The result would be it would get hot right off. A bearing lined with a thin piece of lead adjusts itself immediately accordingly to the pressure, and consequently it runs without any difficulty.

There is another point I would like to refer to. If the oils that we use are so destructive, how is it possible to make such mileage as we do? I have taken out any quantity of them that have run thirty and thirty-five thousand miles before it has worn lead through that was one fifteenth of an inch thick. I have a bearing here which is said to be lined with lead. It has made 75,000 miles to my certain knowledge, and the lead is not destroyed. In fact, I showed it to a gentleman who came into my office a few days ago, and he thought it had not been worn.

I do not dispute the gentleman's position at all; he has examined the thing scientifically, and I am not a scientific man, but only judge

from practical experience. I know that that lead from some cause or other, I cannot tell what, has got a tremendous amount of wear in it. We have used for years what we term lead-lined bearings, and those bearings have made anywhere from twenty-five thousand to thirty-five thousand miles before the lead wears through. If the acids in the oils destroy the lead, increase the friction, how is it that they run so well without getting hot? They certainly obviate hot boxes more than any other thing that I know of. I suppose nineteen twentieths of the journal bearings put in to-day through the country, particularly in the Northern States, are of this kind. Perhaps I won't go south of Pennsylvania, because I know they use phosphor bronze; they use almost everything different from anybody else; but so far as I am able to learn from running their cars on our road, they do not have any less hot boxes than we do.

Mr. Waldo. — Well, I spoke particularly of boxes at high speeds and high pressures, such as the boxes of engines.

Mr. Adams. — I should like to inquire if the passenger cars do not go just as fast as the engines do?

Mr. Waldo. — But the pressure is nothing like it.

Mr. Adams. — That is true, but we have some that weigh fifty tons. Quite a good many do.

Mr. Waldo. — My view is not at all novel in the matter. I asked a mechanical engineer recently, and he said that he never used anything but genuine Babbitt in locomotive bearings. I asked Mr. Dudley of the Pennsylvania road, and he said the same. Now, all I can say is that so far as I know in the best practice the use of those metals is universal where the mileage is sufficiently great to use them. The fact simply is that you do have hot boxes, and it is to provide against the extreme cases that discussion of this kind is necessary. It may be that your bearings lubricate so that in occasional instances you get those remarkable runs, but it is not the average run of your car that you are illustrating here.

Mr. Adams. — I claim it is.

Mr. Waldo. — Then, if it is, there is a time when the box heats; and there is no reason why the box should heat at all.

Mr. Adams. — I have illustrated here that we run 480,000 miles on our passenger trains, as an average, to a hot box. I claim that is a pretty good mileage.

Mr. Waldo. — But I have travelled a good deal, and in one case out of six my train stops for a hot box somewhere between here and St. Louis and Chicago.

Mr. Adams. — Well, I have noticed that myself, and that there is very little of it on the Boston & Albany road. (Laughter.)

Prof. C. Frank Allen. — There is one point in relation to hot boxes that I think has not been brought out. It is not in relation to their prevention or cure, but rather as to the results, perhaps, of hot boxes; and I thought it might be worth while to call attention to it. It was suggested by what Mr. Lauder said in relation to the quality of the lubricant; the cheap lubricants might be found to cost less, but he thought that when you took into account the wear of the journals and all that, if you were able to get hold of it, that the total result would not be a saving.

I think that is all right as far as he went, only I think he didn't go quite far enough. If you are heating boxes, and if you are wearing down your journals in doing it, it will cost something to do that. If you attempt to turn down your axle it will certainly cost something to do it, and if you turn it down under service it certainly costs something to do it. The hot box, I suppose, means friction, and the wearing down of the journal means friction, and it costs you money all the time you are doing it, to produce the friction to make your hot box and to wear down your journal. In other words, you are spending money every day in the week, all through the year, in overcoming friction that you ought not to overcome. I do not know that there are any experiments that will show in dollars and cents just how much there is of it, but I have no doubt whatever that a very large element in the economy of your journals and of your lubricants will be the question of how much power you are expending in doing worse than useless work. I should think it might be possible to take a car and measure the resistance, the friction, when it was first lubricated and the packing was good, and measure it afterwards, after the packing had been in a long time, and when dust and dirt had had some chance to get into it. Take the same car, on the same track, and you would be able in that case to get some idea of what it was costing. I do not suppose you can get at the exact figures, but I have no doubt whatever that they would amount to something that would be pretty serious in the course of a year.

Mr. John Coghlan. — I was interested in hearing what has been said in reference to the lead-lined bearing and its effects on the journal. I had occasion to-day to have a car brought into the shop which has not been in the shop before since Jan. 1, 1890. Bearings having $\frac{1}{10}$ of an inch lead lining, the journal being the M. C. B. standard ($3\frac{3}{4} \times 7$), at that time were put in new. Today when I had them taken out the lead lining was just barely worn through. On looking for the mileage I found that the car had run 56,500 miles, and the weight of the car, wheels and all included, is 49,000 pounds. We run over a very sandy

place. The journal had only worn a little less than $\frac{1}{32}$ of an inch in diameter. If the effect of oil is so great upon the lead as has been said, it would be impossible to have that car, under the conditions in which it is run, with no very great care, remain in that shape, or run that time without some injury to something. It has proved the efficiency and the economy of using a good lead-lined bearing. I have tried all other classes of bearings which are in existence, as far as I know, and have experimented with them, but I have found nothing as economical as this.

I also made an experiment in reference to the increased length of the journal and the diameter of the axle a short time ago. I took an ordinary-sized M. C. B. bearing and reduced it twenty-five per cent, and put it under a car that had always been running cool before that. The consequence was we never could keep that car cool. It wouldn't run eighteen miles without getting hot on account of that reduction of twenty-five per cent. Afterwards I put back again the original full-sized journal, and we never had any trouble.

The discussion was declared closed and the meeting adjourned.

The point I wished to bring out was that it is so easy to provide insufficient accommodations for the future that we need to be on our guard and provide for a considerable time in the future, and, in laying out our yards, to lay them out in such a way that they will be useful at the present time, and also that future improvements can be made without tearing down everything that we have at the present time.

It occurred to me that just a word in this way might not be out of place at the present time. Some questions were asked as to the Edge Hill yard, and I do not care to give any criticisms upon it; but the yardmaster in charge of the yard stated that he thought that the lower the gridiron, the larger capacity would be secured, the more useful in draining water. That answers the question that was asked largely. I have not had opportunity to see the yard in use.

I do not want to sit down without expressing my admiration for the very excellent paper that has been presented. It is perhaps more necessary for me than for many others to know what has been written in relation to such matters previously, and I certainly know of nothing that begins to cover the ground as well as Mr. Turner's paper does. I do not wish to sit down without giving that much testimony in favor of it.

The meeting was then adjourned.

New England Railroad Club.

Responsibility of Car Owners

. . FOR . .

Defects in Freight Cars.

Meeting of December 13, 1894.

Published by the Club.
Francis M. Curtis, Secretary, P. O. Box 1576.
BOSTON.
1894.

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F. D. ADAMS, President,	March,	1883,	to	March,	1885.
J. W. MARDEN, President,	"	1885,	"	"	1887.
JAMES N. LAUDER, President,	"	1887,	"	"	1889.
GEO. RICHARDS, President,	"	1889,	"	"	1891.
FRED. M. TWOMBLY, President,	"	1891,	"	"	1893.
JOHN T. CHAMBERLAIN, President,	"	1893,	"	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Thursday evening, Dec. 13, 1894.

President CHAMBERLAIN occupied the chair, and upon calling the meeting to order requested the secretary to read the following communication: —

MACON, Ga., Nov. 22, 1894.

Mr. FRANCIS M. CURTIS, Secretary New England Railroad Club,
Boston, Mass.:

Dear Sir,— At the regular monthly meeting of the Southern and Southwestern Railway Club, held Nov. 15, 1894, the following action was taken: —

Resolved, That the secretary be instructed to communicate with the secretaries of all the railway clubs, with request that they urge the Executive Committees of their clubs to appoint a committee on Revision of Rules at once, with instructions to communicate to their secretaries not later than April 1, 1895, and that the secretaries be then requested, or instructed, to send the recommendations of each Revision Committee to each other club for discussion at their following meeting, The object of this resolution is to bring about, if possible, recommendations before the Arbitration Committee that will be more uniform in purpose and expressive, from the different clubs, than has heretofore been the case.

We trust the Executive Committee of your club will see the advantages of the course indicated, and that at the next annual convention the changes

recommended shall be what every club, after careful consideration, can present for the general benefit of the service.

Yours truly,

S. A. CHARPIOT, *Secretary.*

It was moved that the communication from the Southern and Southwestern Railway Club be referred to the Executive Committee, with instructions to act as they deem advisable in the matter. Motion carried.

The following communication was also read by the secretary:—

FRANCIS M. CURTIS, Esq., Secretary New England Railroad Club,
Boston, Mass.:

My Dear Sir:— In behalf of my mother and myself, I wish to acknowledge the receipt of a copy of the Resolutions passed upon the death of my father, James N. Lauder.

The sturdy words and the unquestionable sincerity of them, showing so well his personal standing among the members of the New England Railroad Club, outside of any business relations, appeal to us strongly.

The quiet but elegant taste shown in the execution of the copy itself seems in such keeping with the intention of the Club that I cannot help referring to it.

It is with much gratification and many kindly feelings that I ask you to read this letter before the club at its next meeting.

Sincerely your friend,

GEORGE B. LAUDER.

CONCORD, N. H., Dec. 11, 1894.

It was moved that Mr. Lauder's letter be accepted and placed upon the records of the New England Club. Motion carried.

The president announced that the next meeting of the club would be held on the second Wednesday evening in January, 1895, and that the subject for discussion on that occasion would be, "Painting, Paints, and Varnishes as applied to Railroad Equipment."

He then announced the subject for discussion on the present occasion as, "The Responsibilty of Car-owners for Defects in Freight Cars," and said that as this was a subject in which all those having car equipment in their charge in any way were deeply interested he hoped there would be no backwardness in its discussion. He said he had arranged with Mr. J. W. Marden, superintendent of the Car Department of the Fitchburg Railroad, to open the subject, and he would now do so.

Mr. MARDEN. *Mr. President, and Gentlemen of the New England Club,*— The subject for discussion this evening — "The Respon-

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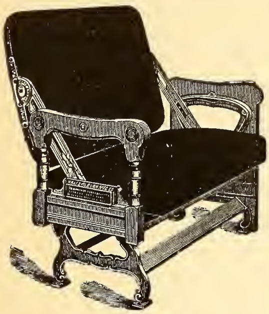

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sibility of Car-owners for Defects on Freight Cars" — is a very important one, one in which the managers of all railroads ought to be interested, for the proper settlement of it means an improved car service, and consequently an increase in the earnings of the road.

If a railroad has the reputation of promptly moving freight trains, and thereby promptly delivering freight to its destination, it will not be long before shippers will find it out, and give preference to that road or line.

The inspection of cars at receiving points has a great deal to do with the prompt movement of trains. A detention of twenty-four or more hours is frequently made by inspectors, and often when the cars could have gone to destination safely without any repairs, simply because the inspection was made for *protection* instead of *safety.*

This we are obliged to do, under our present rules of interchange, for, if a road should receive a car with a cracked draft timber, or a cracked sill, and haul it several hundred miles safely to an interchange point, the chances are that the receiving road's inspector would either demand that this defect be repaired or a defect card given for it.

If a defect card was applied, some road, and possibly the owner of the car, would make the repairs and bill against the road issuing the card, for the repairs that they were in no way responsible for.

There are several reasons why I believe that a change should be made in our rules and that car-owners should be made responsible for defects, except as provided for in Rule 9.

First. In order to inspect for protection, we have got to maintain a larger number of inspectors than we would be obliged to in order to inspect for safety only. In fact, a large proportion of the inspector's time is now occupied in hunting for minor defects in order to demand a defect card, or have the privilege of setting the car back for repairs. But under our present rules they are justified in doing it, for, if they should allow a defect to pass and it was found at some other interchange point, they would undoubtedly be censured for not having found it.

Second. In order to make an inspection for protection, we cause a serious detention to trains for the purpose of such inspection, and, as I have before remarked, any detention of freignt trains causes an expense to the company.

Third. A still further expense, under our present rules, is the switching mileage consequent on the setting back, from receiving to delivering roads, of cars for repairs.

Fourth. The expense of telegraphing to find out why freight is

delayed, and the time of clerical force in Traffic Department's office in answering letters, questions, etc., from shippers and consignees; in fact, there is hardly any end to the expense on account of the delay of freight.

For several years I have given the subject of inspection carfeul study; seeking to protect the road in the matter of charges for repairs which we are not responsible for, and at the same time facilitate the moving of trains and reduce the switching mileage.

At the meeting for the revision of the rules, at Saratoga, June, 1892, I advanced the opinion that the mileage charge on freight cars ought to be sufficient to take care of the running repairs and replace the car when worn out, and thus make owners of cars responsible for running repairs.

I was met by the reply that we were not quite ready for a movement of that kind. I had, however, made up my mind that something should be done, if possible, between the Fitchburg road and its connections, and I made arrangements with one of our prominent connecting roads to take care of repairs on all cars we delivered to them; we to take care of all repairs they delivered to us, with the exception of those provided for in Rule 9, under head of Exceptions. A memorandum charge was to be made, and if either road was not satisfied with the results, the arrangement could be cancelled in thirty days.

It was a success from the beginning, and I now have this arrangement with all of our connections but two; and a plan is now being perfected whereby I think there is no doubt but that all of the roads centering in Boston will adopt this plan. It facilitates the movement of cars, and very materially reduces the switching mileage.

Five or six years ago, the New York, Lake Erie & Western, the D. & H. C. Co., and the Fitchburg railroads entered into an arrangement whereby a line inspector was appointed who had charge of all the inspection between Chicago and Boston. We could see no reason why a car that was considered safe to leave Chicago should not run through to Boston without any detention on account of the defects which it had when it left Chicago.

Mr. F. H. Soule, now general inspector for the Lake Shore & Michigan Southern Railroad, was appointed to that position by the three roads named, and it was his business to travel over the line and instruct the inspectors in uniform practice. A car was not allowed to leave any point until it was in condition to pass the inspection at all points, and a car leaving Chicago for Boston with defects came through with the same defects, without being side-tracked.

Both of these plans have been an improvement over our present

rules of interchange, and the traffic managers have been more than pleased with the prompt movement of freight trains.

I believe that the detention of cars on account of inspection has become a serious evil, and that the matter should be carefully studied and agitated in all the railroad clubs, and brought before the next Annual Convention in so clear a light that there will be no opposition to making car-owners responsible for all defects except those mentioned in Rule 9 under the head of Exceptions; and I am of the opinion that if this plan could be tried for one year that under no consideration would the managers of our roads allow us to go back to the old plan.

In conclusion, I want to commend to your careful consideration the circular which will be very soon issued by the Committee on Interchange of Cars, through its chairman, Mr. Pulaski Leeds, superintendent of machinery, Louisville & Nashville Railroad Co., who, in my opinion, is doing good work in the able manner in which he is placing this subject before the members of the Association.

The President. Before proceeding further with the discussion, I think it may be well to go through this correspondence, as it may bring out more fully some points which the correspondence suggests. Recognizing the fact that the subject which is presented this evening is one of much importance from a car standpoint, I sent out forty or fifty special circulars, and requested the attendance of those to whom the circulars were addressed, and, if that was not possible, asked them to present their views in writing. We have with us a representative from a point as far away as Cleveland. We should have been glad to have one from Milwaukee, but the gentleman could not be present.

The circular is as follows: —

NEW ENGLAND RAILROAD CLUB.

Boston, Mass., Dec. 1, 1894.

Dear Sir, — The next meeting of the New England Railroad Club will be held at Wesleyan Hall, 36 Bromfield Street, Boston, on Thursday, Dec. 13, at 7.30 o'clock, P. M., instead of Wednesday, Dec. 12.

Subject for discussion, "The Responsibility of Car-owners for Defects in Freight Cars," which substantially means, shall Rule 8 of our present code of rules be made broad enough to include the whole car (when not unfairly damaged), or, if not, what other items, if any, should be included in this rule.

As you are aware, this is a subject that is now occupying the attention of a large number of car builders on the more prominent railroads of the country, and a subject which will no doubt have quite a prominence in the

Master Car-builders' Convention at its next session; and, as the subject is one in which there is considerable to be said on both sides, I would deem it a personal favor if you will favor us with your presence at the meeting and present your views on the subject. Should you not be able to attend, I shall be pleased to receive a paper setting forth your views on the subject.

Hoping to hear from you as early as possible, I remain,

Yours respectfully,

J. T. CHAMBERLAIN,

President.

To this circular the following replies were received: —

GRAND TRUNK RAILWAY COMPANY OF CANADA.

OFFICE OF THE MECHANICAL SUPERINTENDENT.

HERBERT WALLIS,
Mechanical Superintendent.

MONTREAL, DEC. 10, 1894.

Dear Sir, — Mr. McWood has referred to me your New England Railroad Club circular, dated Dec. 1, on the subject of the Responsibility of Car-owners for Defects in Freight Cars.

The company which I represent does not desire an extension of Rule No. 8 in the same direction, in fact I do not hesitate to say that we would be quite willing to revert to the system which obtained prior to 1891.

I find that for the year prior to August, 1891, under the old system, which practically exempted everything from charge except wheels and axles, the number of cars repaired and charged for by other companies against the Grand Trunk was 3,252, and for the year ending last August it had increased to 12,519.

These figures, it seems to me, show what we may expect if every trifling defect should be made good at the expense of car-owners.

That car maintenance and clerical expenditure would increase is certain; and one need only go a step further and have car oiling and inspecting included in the new arrangement to put into force one of the most expensive and troublesome systems that could be devised.

I question if any company would gain in any, but it seems certain that all would lose in most directions.

I trust the meeting over which you preside will hesitate before committing itself to any further broadening of Rule 8.

Yours truly,

HERB'T WALLIS,

Mechanical Superintendent.

J. T. CHAMBERLAIN, Esq., Master Car-builder,
Boston and Maine R. R., Union Station, Boston, Mass.

EDWARD CLIFF,
President.

JNO. C. N. GUIBERT,
Sec'y & Treas.

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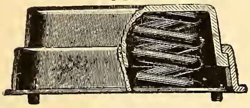

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CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY COMPANY.

OFFICE OF SUPERINTENDENT OF MOTIVE POWER.

West Milwaukee, Dec. 4, 1894.

J. T. Chamberlain, Esq., President New England Railroad Club,
Boston and Maine Railroad, Union Station, Boston, Mass.:

Dear Sir, — Answering your circular of Dec. 1, I have taken a great deal of interest in the matter of responsibility of car-owners for defects in freight cars, as I have for several years been under the impression that our present system, which has been gradually growing for the past twenty years, is expensive, cumbersome, and becoming more instrumental in delaying cars than in facilitating their movements. I think that inspection of cars at interchange points has degenerated into mere inspection of the receiving company, and that railroads are forced to maintain at every interchange point, no matter how small, one or more inspectors, not for the purpose of safety or facilitating business but simply to see that no cars come on the line with defects, for which a card may be demanded at some other inspecting point; the result being that we employ many inspectors at minor points whose services could be entirely dispensed with so far as practical utility is concerned.

Second. That at each of the principal interchange points we employ a large corps of inspectors who spend their whole time inspecting, whereas they should be rendering other service to the company during a large portion of the day.

It will be observed at every point that numerous devices are in operation to evade master car-builders' rules, the principal being that of taking records of the condition of the car. A few days ago I made it a point to look over the books of one of our car inspectors at which point about fifteen cars were interchanged per day, and eighty per cent of these cars were merely switched by another road to various unloading points and then returned. A few of them did not return as above. His report showed that every car was inspected, and I would say that each car showed an average of half a dozen minor defects.

Under the strict interpretation of the rules, every one of these defects should have been carded, and, at the same time, if they had been carded by any one not owning the car that road would have made itself responsible for repairs which were in no ways necessary, and which would not have been necessary unless the car had been subjected to very rough handling.

It will be seen from the above that the inspectors are struggling to avoid carrying out the master car-builder's rules for carding, because the requirements of the master car-builder's rules as interpreted now necessitate carding for defects which every inspector knows that the road handling the car is in no ways responsible for. In fact, at Chicago there are many roads which will not give cards for "old defects" on foreign cars, absolutely refusing to

do so, maintaining that if a car is not accepted in that condition it may be unloaded and returned to them. If the requirement of cards for these defects which roads refuse to furnish is in accordance with the master car-builder's rules, and the roads then would rather transfer than furnish cards, it seems to me there must be something wrong with the rules.

In addition to the above objection, I find that at all our shops we are repairing minor defects on cars which in no way impair their safety, and which might exist without any detriment until the car received general repairs, or was worn out, this being done simply to avoid trouble at interchange points. I think that rules that compel us to do this are wrong.

I enclose you half a dozen copies of agreement which has been entered into at Chicago between the following roads: Elgin, Joliet, and Eastern Railway; Chicago Great Western; Cleveland, Cincinnati, Chicago and St. Louis; Western Counties Railway; New York, Lake Erie and Western; Chicago and Erie; Illinois Central; New York, Chicago and St. Louis; Louisville, New Albany and Chicago; Lake Shore and Michigan Southern; Chicago and Western Indiana; Chicago and West Michigan; Detroit, Lansing and Northern; Chicago and Northwestern; Chicago, Burlington and Quincy, and Chicago, Milwaukee and St. Paul Railway.

This agreement has for its object the avoidance of the difficulties referred to above. By this arrangement a car is free to move if it is safe to run, so far as the most frequent recurring defects are concerned; repairs are not to be made unless necessary, and if any of the items covered by the agreement are repaired the owner of the car pays for such repairs.

The most important objection which I have heard to this arrangement is "dishonesty of roads." If the matter is carefully observed, I am inclined to think that there could be as much dishonesty with the present card system. The principal item in which dishonesty might occur would be in charging for repairs of cars damaged in wrecks or derailment. The charges, however, are so arranged that this could scarcely occur, and even if items chargeable under this agreement were charged in the case of a wrecked car it is no difficult matter to have such cars inspected, and in this way determine if any extended repairs had been made to the car. So far as dishonesty is concerned, I am inclined to think that we have a more complete check on this matter than we have in many other cases, as, for example, "mileage of cars."

I have heard of one other objection, and that is, that roads poorly equipped with cars would have the advantage over roads which are well equipped. While there is room for a great deal of talk on this subject, I am inclined to think that the matter is not of much importance. A few minor and impoverished roads may, as a matter of necessity, endeavor to get along with an insufficieht equipment, but this is not the case in general, and I personally feel on the matter in this way. When times are very brisk and there is a heavy demand for our rolling stock we keep it on the road, compelling transfer at interchange points. If times are very dull we are perfectly satisfied to have other roads use our cars and pay us mileage, and

I think we make considerable more by doing so than we would to retain them in idleness on the road; but I feel that this item is of such small importance that it is not worth while considering.

In conclusion, I would say that we are suffering from delays to cars at interchange points, we are suffering from expensive inspection, and from the necessity of making unnecessary repairs, and that these items are becoming so important that there is a crying necessity for reform in the present rules of interchange.

The experiment as outlined above will have a thorough test at Chicago; and not only at Chicago but with a number of roads connectiug with the roads entering into the agreement at Chicago, and I believe that we will have something definite to talk about at the next Master Car-builders' Convention.

Yours truly,

J. N. BARR,
Supt. Motive Power.

INTERCHANGE BETWEEN RAILROAD COMPANIES.

AGREEMENT.

We, the undersigned, on behalf of our respective roads, agree to interchange cars, with the understanding that, in addition to the defects enumerated in Rules 7, 8, and 9 of the master car-builders' rules of interchange, for which owners are reasonsible, the following items shall also be treated in the same way, viz.: —

1. Couplers or drawbars, drawbar springs, drawbar pockets or spindles, or their substitutes.
2. Draw lugs and attachments, draw timbers, or their substitutes.
3. Dead woods or buffers.
4. End sills.
5. Longitudinal sills.
6. Cracked end and corner posts.
7. Any parts of truck, including brake beams and attachments, failing under fair usage.
8. Centre plates and all body castings.
9. All bolts.
10. Roofs and running boards defective.
11. Loose and decayed sheathing or fascia boards.

It is further understood and agreed: —

First. That if the damage exceeds the items enumerated under No. 1, so as to include any or all of the items under head of No. 2 or 3, that in such case the damage shall be considered due to unfair usage, and no bill shall be rendered; the same agreement to govern in items 2 and 3. Also, that in the case of longitudinal sills no bills shall be rendered for replacement of more than two sills.

Second. That cars which are the property of the railroad companies parties to this agreement shall be interchanged between the parties hereto without requiring cards for defects which may exist in the parts enumerated above.

Third. That in receiving cars from railroad companies not parties to this agreement or in interchanging cars not belonging to parties to this agreement, the rules of the Master Car-builders' Association for the interchange of traffic shall prevail.

Fourth. That nothing in this agreement shall be so construed as to require any of the parties hereto to accept cars which may, in their opinion, be unsafe to run, or unsuitable for carrying freight, or with defects for repairs of which they are not authorized to bill, unless the party offering the car furnishes a proper master car-builders' defect card.

Fifth. That in case any party to this agreement should be required to furnish master car builders' defect cards for any of the items covered by this agreement on cars owned by any party to this agreement, and a bill be rendered on such card, the bill and card shall be a voucher against the party owning the car for an amount equal to the amount of such bill.

Sixth. That if any party to this agreement should find it necessary to make repairs to any of the items covered by this agreement, the damage to said items not having been caused by collision or derailment, then and in such case the party doing such repairs shall have authority to bill against the party owning the car for the cost of such repairs, the charges for labor and material applied, and credits for scrap or good material removed, being in accordance with the master car-builders' rules of interchange, and the party so billing shall certify on the face of the bill that the damage billed for was not caused either wholly or in part by collision or derailment, and that there were no further repairs made or required in connection therewith, the certificate reading as follows: "I hereby certify that this bill is in accordance with special agreement for interchange of cars."

Seventh. That in case any party shall make repairs under this agreement, such repairs shall be made strictly in accordance with master car-builders' rules. Evidence that the repairs have not been so made will be authority for non-payment of bill, or for rendering counter bill in case original bill for repairs has been paid.

Eighth. When repairs are made under this agreement the party making such repairs shall immediately notify the owner of the car, giving date, place, and nature of repairs.

Ninth. In case any party to this agreement may desire any other party to hold material removed from cars, under this agreement, for inspection, the same shall be held, after notice has been received, for a period not exceeding thirty days subsequent to the date of repairs to such car.

Tenth. Transfer roads may become a party to this agreement by assuming responsibility for any new defects which may be caused while cars are in their possession, but shall not be authorized to bill for repairs made under this agreement.

Eleventh. That there be an Executive Committee of five appointed to whom disputes shall, under this agreement, be referred, their decision to be final and binding; also to make rules for the transaction of the business of this Association.

Twelfth. Bills for repairs should not be made for damage when there is any evidence of carelessness in handling the equipment.

Thirteenth. Any railroad may become party to this agreement by notifying chairman of Executive Committee and signing agreement.

Fourteenth. That this agreement may continue indefinitely, and that any party hereto may withdraw from the agreement by giving notice to that effect in writing to chairman of Executive Committee, said notice to be given at least thirty (30) days prior to the date on which such withdrawal goes into effect.

CHICAGO, BURLINGTON AND QUINCY RAILROAD COMPANY.

OFFICE SUPERINTENDENT MOTIVE POWER.

AURORA, ILL., Dec. 10, 1894.

Mr. J. T. CHAMBERLAIN, Boston and Maine Railway,
Boston, Mass.:

Dear Sir, — We have your inquiry asking for our views in regard to the new interchange.

When this was first broached by Mr. Barr at the annual convention, while we saw how desirable such a change would be and how much it would expedite the movement of freight and prolong the service of many parts of our cars, there seemed to be so many obstacles to be provided against before it could be a success that we voted with those opposing the scheme. Since then those who have been developing plans under which such an arrangement might go into effect, at least for a trial, have been very successful, and we believe the plan as now outlined and presented to the November meeting of the Western Railway Club is a start in a move which will eventually materially change the present laborious and expensive methods of car inspection and interchange.

There has been for a long time a desire on the part of many of the master car-builders to make some provision by which old defects, or defects for which the owners are responsible, should be provided for. Various plans have been proposed, but nothing has been successful, and it has finally simmered down to an agreement between inspectors at local points to accept cars with certain defects on notation. They also have been provided for at the annual conventions by gradual additions to Rules 7, 8, and 9. Rule 8 now practically covers most parts of the truck and portions of the body. Additions are made to Rule 8 at each annual convention, and doubtless in a year or two, unless the present new interchange rules take its place, Rule 8 will soon cover the entire car. The operation of Rule 8, however, has not

been satisfactory. As it is, the car-owner has absolutely no check on the bills. All he has to do is to pay the bills and take it for granted that the repairs were necessary and that the charges are correct. The new rules as proposed by Mr. Barr furnish as good a check as can be devised. Section 8, together with the last clause of Section 7 and Section 9 will make it exceedingly difficult for any railroad company to impose upon his neighbor more than once or twice, and we believe Master Car-builders' Rules 8 and 9 would be much improved if they contained similar clauses. Section 12 ought to make the new interchange satisfactory to all managers of railroads. It states distinctly that bills for repairs are not to be made when there is any evidence of carelessness in handling the equipment. With this provided for, it ought not to be a difficult mattter for the master car-builders to work out an arrangement by which bills can be equitably rendered against car-owners. We believe that as many railroads as possible should go into this matter at once, in order that at the coming annual convention we may act on the matter with some intelligence. The rules as at present planned out may not cover the views of all members of the Master Car-builders' Association, but it should be remembered they are susceptible of change, and we believe are as near correct as any rules can be that are drawn up without having the advantage of being based on experience. The vote taken at the last convention in which fully fifty per cent of the members voted in favor of it, and the active interest that is now taken by the different railroad clubs are evidence of a growing disposition for a change in the present system of car inspection.

Yours truly,

G. W. RHODES,

Superintendent Motive Power.

LEHIGH VALLEY RAILROAD.

OFFICE OF SUPERINTENDENT CAR DEPARTMENT.

PACKERTON, PA., Dec. 10, 1894.

Mr. J. T. CHAMBERLAIN,

President New England Railroad Club:

Dear Sir, — I exceedingly regret that I cannot attend the meeting of your club on the 13th inst., at which the question of The Responsibility of Car-owners for Defects on Freight Cars will be discussed. When this question was submitted to the convention at Saratoga I voted in the negative, — not because I did not believe it to be a move in the right direction, but because I considered it one of too great importance to be decided upon without careful consideration. I have since then given the subject considerable thought, and I have arrived at the conclusion that, in addition to the items already enumerated in Rules 7, 8, and 9, of the master car-builders' rules of interchange, car-owners should be responsible for end sills, longitudinal sills,

draw timbers, draw lugs and attachments, dead woods or buffers, roofs and running boards, defective, loose, and decayed sheathing or fascia boards, centre plates, couplers, drawbars, drawbar springs, drawbar pockets or spindles, all bolts, and parts of truck, including brake beams and attachments, failing under fair usage.

I believe that the result of the arrangement entered into by the roads running into Chicago will be of such a nature as to justify the general adoption of such an arrangement by all roads, and I would not be surprised if at the next convention a rule is proposed making the car-owners responsible for the car as a whole, with the exception of defects that may be due to derailment, wreck, or unfair usage. The result of such a rule would be that the roads having the best cars would pay the least for their maintenance, thus getting the benefit of their better construction; or, in other words, it will be the survival of the fittest. The inspection at the different interchange points will resolve itself into an inspection for safety only, instead of the present arrangement, which at many points is nothing more or less than a race between the rival inspectors to see who can find the most defects on the other fellows' cars, leading to extra expense and delays to traffic.

Yours truly,

JNO. S. LENTZ,
Superintendent Car Department.

THE LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY COMPANY.

CAR DEPARTMENT.

CLEVELAND, O., Dec. 10, 1894.

J. T. CHAMBERLAIN, Esq., Master Car-builder,
Boston and Maine Railroad, Union Station, Boston, Mass.:

Dear Sir, — Referring to your circular letter of the 1st making inquiry with regard to my opinion on the subject of responsibility of car-owners for defects in freight cars, in connection with this subject would say that some few years ago I was chairman of a committee of the Master Car-builders' Association that advocated making car-owners responsible for a large number of defects under Rule 8. Unfortunately, the manner in which the Executive Committee allowed the matter to be presented before the association was such that it received a cold shoulder, and but one or two of the items referred to in the committee's report were added to Rule 8. It was, however, the beginning of considerable thinking on the part of many of the railroad men in the country as to the advisability of the suggestions of the committee. Some of those who are now most strongly advocating the broadening of Rule 8 to cover more of the common defects are persons who opposed the suggestions of the Master Car-builders' Association Committee at that time.

My sentiments in the matter have not changed in the least, except that I would go much further in broadening Rule 8 than our committee suggested. Being unable to get the additions to Rule 8 that were desired, I was successful in my efforts to have the suggestions of the Master Car-builders' Committee adopted, as between the roads entering into a joint inspection agreement, at three of our largest interchange points, — at two points taking in five roads each, and at another point taking in eleven roads. The results have been highly satisfactory, and have added greatly to my desire to have Rule 8 broadened.

During the past year arrangements were made, in connection with a special line of cars which ran between Chicago and the coke regions via the Lake Shore, New York, Pennsylvania and Ohio, and Pittsburgh and Lake Erie roads, by which all carding of cars in that service should be abandoned.

Whatever repairs were necessary to keep the cars in safe running order were to be done by the road on whose line the car was at the time, the expense for same to be pro rated between the three lines in accordance with their mileage. This has not only given greater despatch to the cars in this line, avoiding all disputes, but has saved the inspectors a large amount of unnecessary work.

We have also had an arrangement in force for two years between the Pittsburg and Lake Erie and Lake Shore roads by which the inspection between the two roads was entirely abandoned, except simply in looking over cars having hot boxes. We have so far had no bad results from the adoption of this arrangement. In addition to abandoning the inspection, it was arranged that the Pittsburg and Lake Erie Road should do any necessary repairs to Lake Shore cars, and should charge the Lake Shore for it, and *vice versa*, that the Lake Shore should make necessary repairs on Pittsburg and Lake Erie cars and charge them, of course exception being made to cars damaged in wrecks. This arrangement has been working smoothly, and has saved not only in expense at the interchange point but has saved disputes arising from defect cards, and has kept the cars in service and in good running order to a greater extent than would have been under the old interchange arrangement as they would be run if strictly adhering to the master car-builders' rules.

The master car-builders' rules as they now stand have done valued service in facilitating the handling of large amounts of business where the cars of all roads go to all points of the country, but one very prominent feature has been overlooked, viz., that the interests of the Transportation Department in getting freight through to its destination with the least possible delay must be given due prominence. The idea has taken root in the minds of many inspectors that there was only one department in a railroad, and that was the Mechanical Department, and that in the interchange of cars the interests of the Mechanical Department alone were concerned. This has been brought about largely by many complaints that have been sent to inspectors on account of their allowing cars to get on to a road without being properly carded, even though it is acknowledged that the cars

were safe to run, and their was a possibility for considerable difference of opinion as to the need of cards on the cars.

But these complaints coming in, many of the inspectors have felt that their principal duty was to get a torch and scrutinize every visible part of a car with almost microscopic fineness and make note of every defect discernible, endeavoring wherever possible to get defect cards to cover such defects. Of course, such practice, which I may have exaggerated slightly in the above description, tends to greatly delay freight, and cause a large number of transfers which really are unnecessary.

It seems to me that it is in the line of good railroading now to consider the interests of the Transportation Department as the most important, limited only by a due regard for safety to trainmen and safety to the lading of the cars and the train in which the cars shall go. In order to do this to the greatest advantage, inspection of cars should be confined to such inspection as is necessary to insure the safety of the car and the lading. Railroads can only limit their inspection to this standard when they know that they are properly protected in case it becomes necessary to repair cars while in transit over their lines. If Rule 8 of the master car-buidlers' code is extended and made broad enough to take in practically the entire car there need be no fear on the part of any company but what they will be properly protected for any necessary repairs. Carding will be practically a thing of the past, delays will be greatly reduced, transfers on account of defects will be reduced to a minimum, many repairs that are now being done at inspection points at great disadvantage, in order to reap the benefit of the cards, will be done away with, and the cars will not be stopped for repairing except when the defects have reached such a degree as to be detrimental to the safety of the car. Owners, of course, will have the inducement to maintain their cars in the best possible condition, so as to avoid their giving out on the lines of other roads and consequently bills being made against them for repairs. It will be to the interest of every company, both railroad and private line, to have their cars built to the best specifications and with the best quality of material. At the present time we know something about the classes of material that are giving out on our cars while they are on our own lines, but we know but little of the breakage on our cars on foreign lines, and therefore are not always able to determine what the best make of material is in certain lines. We will, under the extension of Rule 8, have information as to all breakage on our cars that require repairs, whether on our own or on foreign lines; this I believe would be a great advantage.

Summing the matter up, I am heartily in favor of extending Rule 8 to cover the entire car, proper precautions and provisions being made to limit the extent of breakage that will be considered as the result of ordinary wear and tear from that which is caused by wreck or derailment. This perhaps cannot be clearly defined at the start, but with a few years' experience I believe it can be done so but little injustice will be done any company. I believe in the end less bills will be rendered than are now rendered under the defect card system; greater despatch will be given to freight, and

large numbers of inspectors can be dispensed with; cars will be built in a more thorough manner and of better material; repairs will be lessened, and those of us who have to deal with cars will be in a happier frame of mind, and will live to a good old age.

As you may not already have received a copy, I take pleasure in attaching a copy of the arrangement that has been recently entered into by some fourteen different roads, most of them going out from Chicago, although the arrangement is open to any road in the United States and Canada who desires to become a party to it, by notifying Mr. J. N. Barr, chairman of the committee. Yours truly,

A. M. WAITT,
General Master Car-builder.

CHICAGO AND WESTERN INDIANA RAILROAD COMPANY

AND

THE BELT RAILWAY COMPANY OF CHICAGO.

83d Street, Chicago, Dec. 4, 1894.

J. T. Chamberlain, Esq., Master Car-builder,
Boston and Maine Railroad, Union Station, Boston, Mass.:

Dear Sir, — Replying to your circular of Dec. 1, this question was taken up by Mr. Barr, superintendent of motive power of the Chicago, Minneapolis and St. Paul Railroad, in the Western Railroad Club, and a committee appointed who, with the representatives of the railroads entering Chicago, framed a set of rules. The same went into effect on fourteen railroads entering Chicago, Dec. 1, 1894.

I think it is a modern move, and one in the right direction, and will lessen the repairs to cars, as now they will be permitted to run as long as they are safe. Before this some rigid inspector, or one who wished to show his company that he was watchful, took a record of all defects he could discover, not that the car was unsafe to run, or that the defect weakened the car, but if any question came up they were protected by rigid inspection. For example, take a car with a slightly damaged corner, which damage did not cause the car to leak for any class of freight, a record must be kept of it by all inspectors for two years or more, until other repairs are necessary; and if carded, the unnecessary repairs would be made so as to collect the value of card, and possibly the switching of car on and off "rip" track, and delay to car was of more cost than the unncessary repairs.

Again, the delay to cars and important freight in these times of watchful competition is a more serious matter than a few cents' repairs would be. If all roads enter into this arrangement it will lessen the inspection fifty per cent, which will more than cover the repairs, as then no record will be

made, but inspection for safety only. One man then will inspect more than two do at the present time.

We have no trouble with wheels and axles. Why not have the cars treated in the same manner, which will greatly lessen repairs and keep freight moving more promptly?

Yours truly,

PETER H. PECK,

Master Mechanic.

The PRESIDENT. I hope those having the care and maintenance of freight equipment will have no hesitation in expressing their views. I don't know as I can do better than to ask Mr. McKenzie, from the Nickel Plate Road, to give us his views.

Mr. JOHN MCKENZIE, of the New York, Chicago, and St. Louis Railway. I had the honor of being a member of the committee which supervised these rules and drew up this agreement. Mr. Barr, Mr. Wait, and myself, who composed the committee, were very solicitous to get up something which would meet the requirements of the railroads, and the culmination of the matter was the formulation of such rules as we thought were applicable to the car-owners. Of course, we are all car-owners; we draw our money for taking care of the cars, and that makes us car-owners. The principal point which it seems would interest the members of the New England Club is as to the responsibility of car-owners. Mr. Barr showed that private-car owners in this country are paying less than forty per cent for the care of their cars. The question naturally comes up, Who pays the other sixty per cent? The railroad companies, naturally. Now, if that is the case, why should we not adopt, under Rule 8, a system that will make the car-owners responsible for the defects upon their cars? We, the car-owners, pay mileage upon these cars; the car-owners get that mileage, and the private-car owners pay only forty per cent of the cost of keeping their cars up. That is a broad assertion; I don't know whether it is exactly so or not, but it seems to me something that the car-owners ought to look at pretty carefully.

The Nickel Plate Road does not own many cars, and for that reason I think we should get the benefit of a better arrangement. As an illustration of how foolishly the car-owners of this country have been carding cars, I will mention this instance. I had a bill come in under this new arrangement the other day for repairs to a car passed over our line in interchange with Buffalo. It was set one side for repairs; it had one key-bolt wrong. That car was put through the joint inspection, and the chief joint inspector came along with a bill against the

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Nickel Plate Road for seven cents. That is an illustration of our car inspection. In this case it cost forty-five or fifty cents to inspect that car. There was no detention.

The delivering road simply delivers the car; the receiving road takes the car under the joint inspector's order, and charges against the delivering road the cost of repairs. In this instance the cost to the delivering road was seven cents to have that car put in good order, and it cost the receiving road forty-five or fifty to inspect the car.

At first I was not much of an advocate of a change, but, being made one of the committee, I had to change my views. The root of this matter of repairs appears in the first, second, and third paragraphs of the agreement, and, as the chairman suggests, they bring about such a condition as allows of no chance for fraud.

The PRESIDENT. Will Mr. McKenzie please read those paragraphs.

Mr. MCKENZIE. The first paragraph says: "That if the damage exceeds the items enumerated under No. 1 so as to include any or all of the items under the head of No. 2 or 3, that in such case the damage shall be considered due to unfair usage, and no bills shall be rendered; the same agreement to govern in items 2 and 3. Also, that in the case of longitudinal sills no bills shall be rendered for replacement of more than two sills."

In that connection I think the opinion of the gentlemen of the committee ought to carry a great deal of weight, because they have considered the matter very carefully, and it is generally conceded that the draft timber can be damaged more or less, or the draft sills may be damaged more or less, but if the drawbars are broken or the draw lugs are broken, and their attachments, there is a clear case of rough usage; but you cannot bill against the owner of a car for either item; and the same may be said of dead woods or buffers; if they are not in when the drafting is knocked out there is evidence of rough usage. The question of centre sills is one that, in my opinion, will bear a good deal of thought; but as the agreement is laid down, if the sills are damaged in connection with either one of the other three you cannot bill. It takes a great deal of hard usuge to knock a centre sill out of a car; and with regard to the centre sills, the question in my mind in connection with this matter is whether the centre sills should be eliminated from the other defects. In that connection, I want to say that I had said to the General Superintendent that I thought the time had come when we should have monthly meetings on our line, to take up the matter of responsibility of breakage in the yard or on the line; that we should have a complete and concise statement of every case of damage done to a car on the whole system, and once a month bring

this matter before the travelling engineer, the train-masters, and the car inspectors, and in our monthly meetings discuss what it is best to do in order to stop this wholesale slaughter of freight cars.

Mr. Barr, in his remarks before the Western Railroad Club, said that the switchmen measured their ability to switch cars by the amount of damage they could do; that if they got hold of a Boston and Albany car which was extremely strong, and of a Boston and Maine car which was extremely weak, the Boston and Maine car broke; and if they can't break a Boston and Albany car with the first punch they will break it the second time. I don't think there is any switchman in a yard who can tell whether a car was broken by reason of another car striking hard, or not striking hard enough; but if the car men could devise some way of getting at the breakage they could show clearly that it was due to rough usage,—unnecessarily rough usage. There is no criminal intention on their part in doing it; they do it without a thought.

And so in connection with this interchange; first, we want to see that our different departments are properly represented before our Association. The Mechanical Department of a railroad does not amount to much; it only costs about twenty-five per cent of the entire cost of maintenance. That is not much. The larger proportion of the expense of operating the railroad is the Motive-power Department; therefore we should have a great deal of representation. I am very much interested in the statement made by Mr. Marden about the originator of this idea of making the owners responsible for defects. I have always been a very strong advocate of the responsibility of car-owners; all the inspection we are doing to-day is for the purpose of placing upon our connections with the delivering roads the responsibility of some slight defects. I will not put that as Mr. Barr does, and say imaginary defect, because if we pay an intelligent man to look for the defect, and he finds it, there is nothing imaginary about it. What we ask of him is a true statement of the facts in the case,—what was the condition of the car when it was delived by the owning line. Well, one key-bolt was wrong, we will say for an illustration. That is placing the responsibility on the delivering road.

The question that comes before us now is, Is it necessary to do that work? I wrote a letter to our car inspector the other day, after receiving thirty or forty statements under this new agreement, asking the reason of so many bills coming from our company to pay, while up to that time we had not received one from any foreign company, and whether it was possible that we were the only road that was going to make bills against foreign companies. I understood, from their being

so prompt and energetic, that they were finding out every little defect, however small and insignificant, when we didn't have hardly men enough to get the cars over the road safely, and they were making so much of every little item as almost to make me believe they had taken this agreement up and dropped everything else, and that they were going to pay all the dividends of the road. I said to the chief car inspector, "Go over the line and find out about it. We are not getting any bills in exchange; we are making bills for our road." He said, "We will make money out of it, for the reason that we have got 6,000 cars of our own running over our line, and we are handling 25,000 thousand cars." Last year we paid $25,000 excess of mileeage. Now if a railroad that has not many cars interprets this agreement carefully, it is going to make the railroads that run cars over its line pay for it; that is all.

The question of making the car-owners responsible is one that should be looked at very carefully. What Mr. Barr said with reference to private-car owners shows that this is a matter of large magnitude, and requires you and me to think a good deal. We are giving them the benefit of the repairs upon their cars. Now, we have, in connection with this agreement, at Chicago two or three private-car owners there who say they will go into it as soon as the majority of the railroads will go into it. We have got fourteen roads in Chicago that have entered into this agreement. There are one or two others, one side, who claim that they have improvised a system of handling their cars whereby they saved $250,000 or $300,000 last year in switching, but they don't propose to give any railroad the benefit of it. I think if there is anything new of that kind, not patented, we should get the advantage of it; but they refuse to tell how they did it. But the idea will be now, that if we can get the New England roads into this arrangement we will bar those fellows out, and until we learn how they do their business we will not have anything to do with them.

Mr. Marden. I purposely made my opening remarks short, because I knew there would be considerable discussion on this matter. I wish to say now, in reference to Mr. McKenzie's remark concerning the 6,000 cars which are owned by his road, as against the 25,000 cars that run over it, that this fact should be considered: When he made the charge for that bill he spoke of he probably paid the road that ran that car over his road a mileage that would be more than sufficient to take care of the charge covered by that bill, and so I don't think he will make so much money as he thinks he will. I think the roads that own the 25,000 cars as against the 6,000 cars which his road owns will sum up the mileage against him to a large amount, and I think

the mileage charged on freight cars will finally make good the expense of repairs.

Now as to the point of yard breakage: On the Fitchburg road, for several years we have had in operation a system of reporting yard breakages. We follow it up very closely, and the report comes to my office daily. I immediately send it to the General Superintendent's office, and he looks over it carefully, and he then sends it to the division superintendent in whose division the breakage occurs. The division superintendent takes it up with the conductor of the train or the yard master, and finds out why the breakage occurred, whether it was by rough handling or otherwise, if possible to get at the reason of it. Since we have had that plan in operation the yard breakages have decreased more than one half.

Now in relation to the plan we have in operation in receiving the cars of connecting roads on our line. I first thought of this matter on account of two of our connections having so long a distance to set cars back for repairs. At one point they were set back three miles, making the distance six miles for the cars to travel, and at another point they were set back two miles. I made an arrangement with two or three of the roads by which we were to take care of all the repairs of cars delivered to us, and they were to do the same with cars delivered to them, with the exception of slid wheels, which were covered by the exception in Rule 9. I noticed immediately after that went into operation with one of the roads, that where they had been sending back to us a large number of cars daily for repairs, when they received the cars and were not privileged to set them back they went along over the road; in other words, when the inspector found he wouldn't have the chance to set the car back, when he had got to do the repairing himself, he let the car slide.

The President. Did he have any right to charge you with repairs when he made them?

Mr. Marden. No, only under the exception in Rule 9. I have no doubt the same thing occurs on our side of the house, — that our inspectors allow cars to go on which, under the old arrangement, would have been stopped. I made the suggestion to a man in charge of the repairs that undoubtedly there would be less repairs made, and the cars would be allowed to pass to their destination without them. He said, "No, my inspectors wouldn't dare to let a cars pass, because the inspectors at other points would catch him up on it." But one of my inspectors, who is present here to-night, stated to me as a fact that at the point of interchange a large number of cars did pass without repairs that would have been sent back if it was allowable. Now the

only thing I can advocate, instead of making the car-owners responsible, is this: Let every road take care of the repairs, and let the mileage pay for it. When we do that we will stop one of our clerical reports. If we make the car-owners responsible, the only objection I can see is that we will have to make a larger number of bills than we are doing, and that will increase our clerical reports. Of course our object is to get the cars over the road safely and to help the departments make money for the roads, and the more simple we make our arrangements to that end, while at the same time aiming to have them effective, the more likely we are to succeed in accomplishing that purpose.

The President. I will ask Mr. West, the president of the New York Railroad Club, to favor us with his views.

Mr. George W. West, of the New York, Ontario and Western Railroad. I thought this was a matter of much importance for me to decide, and so I took it up with our General Manager, after receiving Mr. Chamberlain's invitation, and he endorsed my views in regard to it. I think there are many benefits to be derived from this new method of interchange. I think that three quarters of the bills we receive are from nine to fifteen months old, and they show a great many defects. Now, if the carding is to be with reference to safety only, and the responsibility for defects is to be placed upon the owners of the cars, where it properly belongs, it will certainly be a very great improvement upon the system hitherto in use.

We have been keeping a record for three months, and we find that we have removed fifty per cent of the cards that were originally applied to cars at interchange points, and that cars have sometimes been gone three to five months and come back without repairs having been made during that time. We received a car carded for one side, one intermediate and one centre sill. That car was put into a heavy train, and was broken in two, and to that extent the car would have to be rebuilt. Under the rules, we could not charge for any defects for which the car was carded, because the car was broken by the other company, and, under the rules, the other company would be responsible for its defects, which, I think, is proper. The new arrangement will tend to equalize matters and place the responsibility for defects where it belongs.

Mr. F. D. Adams, of the Boston and Albany Railroad. In regard to this matter, it seems to me that the ground has been thoroughly covered. I will say, however, that I am heartily in accord with the sentiments of the letters which have been read, and of the speakers. At the time this subject was broached or sprung upon the Convention at Saratoga I saw that Mr. McKenzie and quite a number of others were opposed to it, and I thought it was a wild scheme; but I had to

give in subsequently. I knew there was a great deal of trouble existing under our present system of rules, but I had not any way arranged any scheme in my mind to help the matter. Mr. Barr's suggestion contemplated a radical change. After I got home I thought more about it, and looked the matter over, and the more I considered it the more favorably I thought of it, and I wrote Mr. Barr a letter and told him I had changed my views very materially, and was quite favorably disposed towards the plan. And the more I consider it the more I believe we have got to adopt it or something equivalent to it.

In conversations with those connected with our own immediate roads, the car masters here, I have been led to think that it would be good policy to go further than the Chicago arrangement does. Mr. Marden tells us of his experience of two or three years with his plan of interchange, and he has evidently got a good arrangement. I did not know it had been in operation so long; it was new to me within three or four months. If I understand his plan of management with the other roads, he has up to the present time had no bills to exchange either way; it has been satisfactory to the cars, — they move with greater facility,— and has met with satisfaction on the part of the freight agents; and there is no grumbling, there is no trouble; the consignees are pleased, and everything goes pleasantly and smoothly, with hardly any machinery about it. If the cars have got to be repaired he repairs them and sends them along; if he doesn't think repairs are necessary he lets them go. There is no question that about nineteen twentieths of the repairs upon our cars, with the stoppages, the shutting down, stopping them and setting them back, is perfectly unnecessary. Everybody knows that; and I don't think the bolt Mr. McKenzie referred to injured the car materially, and probably it would have run safely to Chicago if nothing had been done. There are many parts of a car that may be damaged without impairing its safety in the slightest degree, but the inspector will require a card for it or set it back, and there is a consequent delay of twenty-four hours, and perhaps many days, because there may be a dispute arise which requires it to wait. These things are very objectionable, annoying to the consignees, annoying to the freight agents, and annoying to the men in charge of the Car Department; and yet there did not seem to be any remedy for these troubles, because everybody felt that the rules must be observed, and if they were not, difficulty would ensue. The delays have been very serious with us. Sometimes I have thought this trouble grew out of a little revengefulness, perhaps, on the part of the inspectors, but you cannot seem to fix it there: they are all happy; but there is the rule, and you cannot go back of it.

There is one rule I have tried myself, and I have tried to keep to it, in regard to replacing low brake connections. This has caused us much trouble. We have had a great many cars set back on us, for the reason that cars that have come from the Southwest and passed some inspectors, on reaching some point on the road farther on are stopped right there, and stand for weeks, because we will not fix the brake. The rule says two and one half inches above the rail, but some are not over two inches, or an inch and three quarters, and that is not according to the rule. We will not take such a car and fix it, and we are stubborn about it; we will not fix it, for two or three reasons. One is, that was not the spirit of the rule, even if it says so; the other reason is that we have no right to manipulate the brakes of other people's cars. When that rule was made, in 1890, it was with the clear and distinct understanding on the part of the managers of every road in this country, so far as I know, and I believe that I am right, that the intention of that rule was that cars built after 1890 should have their brakes two and one half inches above the rail, and the brakes and attachment of the cars already built should not be subject to that rule and were to be kept running; but unfortunately our Association is not posted in niceties of language, as a lawyer is, and everything is not expressed just as it should be. We are hardly expected to do that, and so we did not get that feature into the rule distinctly and plainly, so that it was fully expressed and fully understood that way, in the letter of the rule; but it was understood so fully by the members of the association that nobody thought about it until this difficulty came with the roads connecting with us. We have had much trouble on that account. We have tried to get the rule altered, but the association do not see fit to alter it. I mentioned this to show how the rules stand in the minds of some of the inspectors, and how they are governed by the rules literally interpreted. Sometimes the car masters were strict enough to adhere to the letter of the rule, while the generality of them understood that the rule was to be interpreted according to its spirit and its real intention. If it were so understood universally it would be all satisfactory, and consequently would always work very well; but it does not work well now, it works badly.

Now, if we can get this thing changed, and wipe out these old rules which are so objectionable in many of their features, and get something simple, like Mr. Marden's plan, which amounts to this: "Here, you take all the cars we give you, and we will take all you give us, and we will keep a memorandum of the bills, and at the end of the year we will compare notes, and see how the balance is to be adjusted,"— that would be an immense advantage to

the railroad business. If we are going to make charges for everything we do to cars we shall have to have considerable more clerical force, while we might save something on the inspecting force; but I should be much more in favor of some plan like Mr. Marden's. I am in favor of any plan that will make this matter of inspecting cars easier, and have the inspection for safety only, or have such inspection as will prevent one road from crowding upon another. A rule of that character must be made, which will be more equal in its application, not giving one road any advantage over another.

There is one other point which Mr. McKenzie alluded to slightly, and that is in relation to private cars. The private-car owners have always been very sensitive about their cars. You have got to be very careful in making bills against them; they are very tenacious about it; they do not want bills made against them that indicate anything that they are responsible for. They say, "You broke the car: you must fix it." It makes no difference if the car was poorly put up, or if it is worn by constant wear and tear; they act like mules when these things are explained to them, and they will not pay for the repairs. Now I would like to know why the private-car owners who run their cars over the different roads, and charge the roads with mileage for them, which is meant to cover the expense of wear and tear, if that was the design of it, should be paid twice for their cars, as they are when we pay them mileage and pay for repairs to their cars; that is, do the repairing ourselves, and not charge it to them. Under these conditions, it is not to be wondered at, as Mr. McKenzie says, that the railroads which do not run private cars pay sixty per cent of the cost of maintenance. I should think it would be nearer seventy-five per cent. This is quite a large expense. The private-car owners are increasing; there is a very large number of cars running to-day owned by private companies, and they are running them because they make money on them,—and they will make money under the present system of rules. Now, if we make a rule making the owners of all cars responsible for their own repairs, why, there will be no kicking on that score; we will deal with the private owners as we do with the others, and they can't complain. In the first place, I do not believe they are entitled to the same rules we work under; I have always claimed that, because there is no reciprocity at all, they never repair our cars,— we repair theirs, they not ours. With other railroad companies it is quite different. The railroad companies pay them mileage and repair their cars, to a great degree, without any compensation.

Mr. McKenzie. I would like to emphasize what I have said by a few additional remarks. Mr. Adams has brought out forcibly the

matter of the owners' responsibility. In bringing this matter before the people in Chicago Mr. Barr has placed it as the Chicago interchange. Mr. Waitt and myself, being a little broader in our views, had that striken out. I want to say it is not the Chicago interchange, it is the interchange of cars generally, interchange between railroad companies. Mr. Barr, in opening the discussion before the committee, said in his preamble, "Whereas a large number of inspectors are employed in inspecting cars for protection, this can be done away with, and a large expenditure of money saved by inspection for safety." In other words, instead of inspecting cars to find something that may be repaired, inspect them to make them safe. That will come when this plan of interchange is inaugurated throughout the country. In Chicago there are sixty-nine men employed at the stock yards as inspectors; we employ five men, and one man can do all that is required if we inspect for safety alone. Taking into consideration all the cars that are run, inspection for safety alone would save many thousands of dollars to the railroads. This change has got to come, and it is for the car-builders to bring it about. The freight agents all over the country are continually complaining about delayed cars. There is no question there is something in it. Take our little inspection in Buffalo, where the delivering road has nothing to say about inspection, and the delivering road pays for repairs; the delivering road is paying more than is necessary, and, in my opinion, under any such system it is going to be the survival of the fittest. Under the new plan, the roads will keep their cars in condition, and repairs will be less required. We will have a regular clearing-house arrangement, and if one road has a bill of $2,000 against another road, and the other road has a bill of $2,010 against the first road, there will be a difference of $10 to be paid, and no clerical work is required; and where we keep now four men in Chicago, two men will do the work, because if a car comes from Milwaukee and needs repairs not required for its safety, it can be sent along, whereas otherwise it would have to be held there, and the repairs could not be made until cards were furnished. Now, if we are honest in this matter, and go into it with the spirit that the master car-builders' rules shall be properly interpreted, doing only the work that is absolutely necessary and nothing more, a great deal of this inspection will be done away with, and the men, instead of inspecting cars, will be repairing them, and instead of looking for a loose nail or some other trifling defect, they will be doing actual service; and instead of two men being required to inspect thirty cars, one man will inspect forty cars, and let them go on. I think a better condition of the running gear of the cars will be brought about if we

can bring this system of inspection into line, and if we can make it hold good.

The President. The members will remember that in the circular which I sent forward to these outside parties, and which resulted in the replies I have read and the attendance of our friends McKenzie and West, I said there were two sides to this question. We have with us a gentleman this evening who may or may not take the opposite view from what has been expressed. Mr. McKenzie has said that private cars pay only forty per cent of the cost of maintenance. Mr. Adams thinks that is pretty correct, perhaps too high a percentage. I think Mr. J. B. Fletcher, superintendent of the National Car Company, will undoubtedly have something to say in relation to that which will perhaps change the figures set forth by the authority which Mr. McKenzie quoted.

Mr. J. B. Fletcher. I have nothing to say on the subject. As far as the line which I represent is concerned, its managers are willing to accept any arrangements that the roads enter into generally.

Mr. Adams. There is one thing I want to speak of which nobody has yet mentioned. While we are talking about saving expense and cost, I think there is one point that we ought not to neglect, and that is the air-brake question. The air-brakes are not cared for as they ought to be, neither can they be cared for as they ought to be unless there is some expense attending. Now, it seems to me, from my examination of that matter, that at all large terminals or important points through the country there should be such a plant as is now in operation at Buffalo, in the New York Central yard, and in other places where the plant exists.

Mr. McKenzie. There are several in the West.

Mr. Adams. That thing is a very important appendage to a railroad, and necessary to its success. We go to the expense of fifty dollars a car to apply the air-brakes; and I think that quite a large proportion of them where they have been applied are not in order to work, because there is no way of inspecting them, only when the engine is hitched to the train. There should be a plan by which, when those trains come in, the cars can be attached to pipes or pumps to test the brakes and see if they are in order to do their work. It can be done very quickly indeed if the preparations are made properly. This is not thought of as much as it ought to be. I don't think railroads generally consider it in the light in which it should be looked upon. They put on the air-brakes and test them at the shops when they go out, and that is all the testing they get. They get out of order, and consequently there is a loss of the use of the money expended upon them.

We put on these brakes, and we cannot avail of their benefits as we ought to. Of course it would entail some expense if we went into this matter systematically; but I think there should be such a plant, say, at the terminus of our road at this end, and perhaps at the other end of the road, possibly in the centre; and so with all other roads, — two or three plants where the cars would pass through on the road, to test the brakes at such points. At present the engineer tests the brake, and if it does not work he cuts it out and goes without it. If a car is set aside the brake does not get repaired, if it needs it. I think that is a matter important to be considered.

The PRESIDENT. We have with us Mr. Robertson, of the Central Vermont road, who is doubtless interested in this matter, and we should be glad to hear from him.

Mr. W. J. ROBERTSON. I received a copy of the November proceedings of the Western Railroad Club, and it included Mr. Barr's paper on the new plan. I considered at first how it would work. I studied over it, and, after hearing the discussion to-night and the reading of the letters from the Western States, I am convinced we have got to make a change of the Master Car-builders' Association Rules. We have a good deal of trouble on our road. If there is a loose board, or a board shaken on a car, we have to card that car. I have signed bills for one fascia board lost off. That is all wrong. Sometimes nuts are shaken off, a plate dropped down, or a bolt has come out, and some road has to pay the bill, simply because our inspector cannot hold that car, because it contains important freight, and if the master car-builder should determine to hold that car it would lead to censure on that department. Those things should be remedied, and I would just make this suggestion, — that this new plan is in the right direction, and between now and the time of our next annual convention the matter should have full consideration from the master car-builders. Let us go to the next convention with this thing all ready, and get something passed to avoid the delays of freight at inspecting points, and not have domestic roads repair foreign cars at their own expense, which they should not be called upon to do. Let us study the thing carefully, and be prepared at the next convention to give the matter full discussion, and take some action at that time to have this thing right and as it should be, and avoid the trouble we have been having.

Mr. ADAMS. It is suggested to my mind, and to some others near me, that it would be proper for this Club to place itself on record in regard to this matter, and to that end I make this motion:

That the New England Railroad Club heartily approves the movement proposed for the interchange of cars, in addition to Rules 7, 8,

and 9, making freight-car owners responsible for defects upon their cars. Motion unanimously carried.

Mr. McKenzie. I want to say that this interchange is for the government of the railroads generally, and not for Chicago alone, and any manager of a railroad who signs the agreement becomes a member of the committee of which Mr. Barr is the chairman, and the cars of his road may interchange at any point.

Mr. Robertson. Considering this new movement in the matter of car inspection, supposing that the Boston and Maine, the Concord and Montreal, the Central Vermont, the Lake Shore, and the Nickel Plate roads are all in favor of this new movement, and the Rome, Watertown and Ogdensburg road should not be in favor of it, how would the business be managed between the roads in favor of it and that road which was against it?

The President. Let the Central Vermont buy up the stock of that opposing road. (Laughter.)

We have with us a gentleman who has come all the way from the hills of New Hampshire, — Mr. Gordon, of the Concord and Montreal road, — and we should be pleased to have a word from him.

Mr. J. T. Gordon. Mr. President, if you had called on me earlier in the evening I think I could have made a speech. I will say that I fully believe in this new arrangement that has been proposed for the Western roads, and I hope it will extend to here. I remember that not very long ago there was a car that had gone up through our yard which was inspected and marked out. It was shipped back into our yard and into the shop, and, my time not being very valuable, I personally bossed the repairs of that car. I took my watch out, and saw how long it took, and the work on the car was completed in three minutes. That car was shifted out of the shop on to a siding, taken to the other yard, and made into a train, and went home happier, no doubt. Now, I have no doubt that that three minutes' work cost the two companies fifty cents, and it might have cost them several dollars. Cars passing over our road are thoroughly inspected at Concord; on reaching Manchester, eighteen miles from Concord, they pass through another inspection, about twenty-five per cent of them, and the rest run to Nashua, over a perfectly level road, and there they are thoroughly inspected again, perhaps twenty-five per cent of them; that is seventeen miles further. About twenty-five per cent of those cars are drawn twenty-four miles and pass through a thorough inspection there. Now it seems to me that is an expense for nothing. I think we have at Concord ten men, Manchester seven; until within the past eight months we had nine at Nashua; we had joint inspection previous to that. I

think our road had seven men at Nashua, Boston and Maine six; at Manchester we had eight, and they had four there, I think; at Concord we had seven or eight men; we have in Concord now twelve men, night and day, and at Nashua at the present time we have two. It seems to me that two men at Concord, days, and two, nights, would do the work, and inspect these cars so that they would be perfectly safe to run, and we should be saved an enormous expense of car inspection. I believe fully in this new move.

Mr. McKenzie. Mr. Robertson asks about the responsibility of railroads which may not be in the interchange. Now, if he will read the second and third paragraphs of the agreement he will see what provision is made for them, and that in the interchange of cars not belonging to parties to the agreement the rules of the Master Car-builders' Association for the interchange of traffic shall prevail.

While I am up I want to thank you as the president of this Club for your kind invitation to me to attend this meeting, and for the kind and attentive recognition I have had while standing on my feet. I may tire you, but at the same time I am with you. It is the first time I have had the pleasure of attending one of the New England Club meetings. We want to have you at our next January meeting, and Mr. Waite will, no doubt, give you a pressing invitation to join us in discussing this matter at that point. When it comes to inspection, you will think Buffalo is the only point in America where we inspect cars.

The President. I thank Mr. McKenzie for his compliment. I will say that I have been in his company when I have been tired, but not to-night. (Laughter.)

Mr. Marden. I think, Mr. President, that the members of the New England Club will bear me out in saying that we hope Mr. McKenzie will not get so tired to-night that he will not come again, and I for one will say that I hope he will. I am inclined to think, from the illustrations of inspection that we have had to-night, especially from Mr. Gordon, that we shall think Buffalo is not in it at all.

Adjourned.

NEW MEMBERS.

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F. H. Carter, 21 Exchange Street, Boston, Mass., care of A. & E. Burton.

F. H. Eddy, G. F. Car Shops, Fitchburg R. R., Fitchburg, Mass.

R. F. Gerald, 134 Pearl Street, Boston, Mass., care of S. C. Nightingale & Childs.

Geo. Gray, 12 Marshall Street, Boston, Mass.

Chas. L. Gilpin, care of W. Dewees Wood Co., McKeesport, Pa.

W. S. Gowell, Car Inspector B. & A. R. R., So. Framingham, Mass.

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C. E. Rood, 735 Delaware Avenue, Buffalo, N. Y.

J. W. Ripley, Mechanical Engineer, 620 Atlantic Avenue, Boston, Mass.

A. H. Sabin, P. O. Box 85, Long Island City, N. Y.

C. Scott, Jr., 1028 New Market Street, Philadelphia, Pa.

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D. J. T. Oldham, 3 Cedar Street, New York City.

Geo. B. Topliff, 54 Kilby Street.

Grafton Upton, care of Railroad Commissioners, 20 Beacon Street Boston, Mass.

Charles H. Dale, 16 Warren Street, New York City.

New England Railroad Club.

Painting, Paints, and Varnishes as Applied to Railway Equipment.

Meeting of January 9, 1895.

Published by the Club.

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1895.

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JOHN T. CHAMBERLAIN, President	" 1893,	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, Jan. 9, 1895.

President JOHN T. CHAMBERLAIN occupied the chair, and on calling the meeting to order announced that the Secretary had a communication from the Secretary of the Southwestern Railroad Club, stating that the members of the New England Club who do not receive regularly the printed Proceedings of that club could do so by notifying him, and that Mr. Curtis would forward the names of any such members if desired; and the same would apply to the Proceedings of any of the other railroad clubs.

The President asked if there was any business to come before the meeting.

Mr. JOHN KENT. It is known to some members of this Club, I think but a few, that the grave to-day closed over a man of whom those who knew him would speak in the most kindly and genial manner as a pleasant companion. He was a member of this Club, and I think the members generally will agree with me in supporting this resolution which I offer: —

Resolved, That this Club desires to place upon record its testimony to the friendship, moral excellence, and worth of their former associate, Mr. George Dunbar, who has so lately been removed by death, and

that his memory will be tenderly cherished by those who know his manly character and kindly disposition.

Resolved, That the Secretary of the Club be instructed to send a copy of this resolution to the remaining members of Mr. Dunbar's family.

Mr. James Smith. It is with a degree of sadness, and yet with pleasure, that I rise to second Mr. Kent's resolution. I have known Mr. Dunbar for a great many years, and have done a large amount of business with him, and I want to record my testimony to the effect that in all the relations of life he was a most excellent man and a gentleman, a Christian gentleman, a man who knew how to present himself in any society he entered. I attended his funeral to-day in St. James's Church in Roxbury, where he was a member for a great many years. A goodly number of his old friends were present. He was a man that was in good circumstances. At one time in his life he was a little unfortunate, but he did not lose his honor. I am proud to say that he was a man of truth and uprightness, and I took great pleasure in associating with him. I used to call frequently at his house during the last three years, and spend evenings with him. He was a good violinist and a good singer, and he always entertained me very pleasantly. I do not know when I have lost a friend whose departure I regretted more than that of Mr. Dunbar. He died very suddenly of heart failure in the Emergency Hospital.

The resolutions were unanimously adopted.

The President. Our Secretary has received a copy of the Catalogue of the Exhibit of the Pennsylvania Railroad Company at the World's Columbian Exposition, inscribed with the compliments of that company to the Club. If any one desires to see the book, he can do so by applying to the Secretary.

The subject for discussion this evening is "Painting, Paints, and Varnishes as applied to Railway Equipment," to be opened by Mr. Charles Richardson, who will be followed by Mr. Sabin, of Edward Smith & Co., of New York. After that the discussion will be open to the various gentlemen connected with car painting, painting-shop foremen preferred; and afterwards we should be glad to hear from any others on the subject.

PAINTS AND PAINTING.

BY CHARLES RICHARDSON.

Gentlemen, — The subject I present to you this evening for your consideration will not be as entertaining as was the address delivered by our friend Mr. Twombly, giving his experience of life in Mexico.

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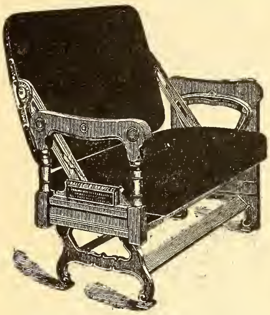

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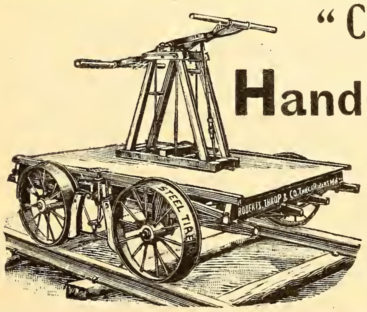

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THREE RIVERS, MICH.

I have no young ladies of flaxen hair and blue eyes, nor young ladies of red hair with black eyes, as were presented to you by our friend Snow in his address on his travels in Norway; still I shall make an effort to hold your attention for a short time.

It is the master mechanic who carefully looks after all matters assigned him, and every caution is taken to make the transportation of passengers and freight safely and as quickly as is prudent. Then comes the master car builder who displays his genius in making the car comfortable and attractive for the passengers. Palmer and Creamer must not be left out, as with their methods of ventilation, which are placed beyond the control of the passengers, we get fresh air, feel no draught, and are relieved from the unpleasant cinder, which make our journey more enjoyable and healthful; but with all these pleasing features we want more, and so we call upon the master painter and decorator to display his ingenuity in completing the work.

As lead is to be a very important factor in my remarks, I desire you to pardon me if I diverge a little. The history of lead is very interesting, and I doubt if there is any other metal mined that has a more diversified history. Lead received many names in antiquity; according to Pictet, it has had as many as thirty names in Sanskrit, several of which it bears in common with tin. It was often that tin, lead, and silver were all classed as lead. I cannot help feeling that the first corroded lead was accidental, brought about with no intention of producing what was produced. We find that white lead was used as a medicine, and also as a cosmetic in connection with cinnabar. White lead was used as a remedial agent in the preparation of plasters and ointments by the Egyptians, Greeks, and Romans. Paracelsus boasted that he could cure two hundred different diseases with lead. In ancient times the old, the young, the married, and the single resorted to the use of lead as a means of improving their appearance. In its natural state white lead served as a powder, and, colored with the juices of plants, — generally the Anchusa Tinctoria, — as rouge for heightening the color of the cheek.

Theophilus describes the composition of the colors to be used in painting faces as follows: Take ceruse, put it dry and without grinding into a copper or iron vessel, place it upon glowing coals and burn it until it is converted into a yellow color; then grind it and mix it with white ceruse and cinnabar until it is converted into a color like flesh.

Lead (or Saturn, as they termed it) was one of the oldest metals, and so named in honor of the oldest and consequently the father of the gods. Boerhaave says: "As Saturn, in all ancient myth-

ologies, is considered to be the father of the gods, so lead is the father of the metals, and at the same time their destroyer." Lead was often used as money. The oldest coin known was that of Lydia, and medals and tokens were issued in great quantities.

According to Pliny, minium was held in high estimation by the Romans in ancient times. He says it was used in former times for sacred purposes. The face of the statue of Jupiter was painted with it. It was also used on festive occasions, and when victorious generals entered the city in triumph their bodies were painted with this substance. The pigment referred to was probably cinnabar.

The addition of lead to bronze was first made for practical reasons, but the quantity was finally increased and became a sophistication which was made the subject of a decree in the third century, by the provisions of which bronze containing more than a certain quantity of lead became subject to confiscation.

The ancient navigators at first used bags of sand for anchors; sometimes stones with holes drilled through them to receive the rope answered the purpose, and frequently stones securely fastened to a stout wooden frame were used, such as may, perhaps, be seen to-day as part of the tackle of a dory of a shore fisherman on the coast of Massachusetts Bay, where it is called "killick." The Phœnicians used wooden anchors of this description, but instead of stones their anchors were provided with masses of lead to furnish the necessary weight. The anchors of the early Greeks consisted of large wooden pipes filled with lead. Diodorous relates that on the occasion of the first voyage of the Phœnicians to Spain they obtained more silver than their ships could carry, and took the lead from their anchors and replaced it with silver. The Apostle Paul refers to the use of lead in sounding in the sea, and Herodotus speaks of throwing the lead, Hoffman refers to the story of Philetas, a teacher of Ptolemy Philadelphus, who was so thin that his companions asserted he wore leaden soles to his shoes to prevent being overturned by the wind. Pliny says he saw a man, named Athanatus, dressed in a harness of lead, weighing five hundred pounds, and wearing leaden sandals, walking about on a stage, thus showing his great strength.

The Emperor Nero, for so the gods willed it, could never sing to the whole pitch of his voice unless he had a plate of lead upon his chest; "this," says Pliny, "showing us one method of preserving the voice."

It is believed that mines were opened and extensively worked in Hungary and Austria by the Romans. Extensive workings of a very remote period have been discovered in those countries in which gal-

leries of enormous length and shafts of great depth have been explored; and as these huge excavations were made before the use of gunpowder for mining purposes, they must have been the work of thousands of slaves, extending through many centuries.

From the earliest historical period those convicted of crimes against the state have been condemned to work in mines. This custom prevailed in Egypt, Greece, and Rome, and has been general until recent times. It has always been understood that captives in war were bound to work in these mines.

It would be difficult for me to give just the time when lead was recognized as an important factor; but the ancient Romans attained much skill in the preparation of pigments, and the manufacture and sale of colors were a well-established branch of industry and commerce. One of the shops discovered in the excavations at Pompeii had jars of pigments displayed in long rows ready for sale to the artist and painter; and I find in the thirteenth century they were used considerably. In the twelfth and thirteenth centuries the dwelling-houses in London were rarely of more than one story. The dwellings of the middle and lower classes were of wood, and generally of one story, and without chimneys or glazed windows. Such a condition of domestic architecture furnished little encouragement for decoration. The exteriors of some of the castles were whitewashed, and some of them referred to by Mrs. Merrifield indicate that they were occasionally painted.

CORRODING.

Their system of corroding was very simple, often consisting of boxes with small twigs upon which thin layers of lead were laid and vinegar poured upon them, and sometimes sour beer and the like. The process generally known as the old Dutch slow process should be credited to Italy, where it prevailed before it was adopted in Holland. From that time to this there have been various experiments in the manufacture, to simplify and reduce cost of pure carbonate of lead; but as a rule the slow process takes the lead in all countries. We have to-day quite a variety of inventions to increase the quantity and reduce the expense by some new, quick process, such as acids, heat, electricity, etc. Each one has its friends, but I cannot help but feel as the old lady did when she was asked her opinion regarding the incubator for raising chickens. Her reply was that she did pity those little chickens that were allowed to grow up without their mother's care. She believed the old method was best. I must take the same stand in reference to the corroding of lead; as a whole, give me the slow process, which is principally known as the Dutch process.

A fair approximate estimate by an expert who is well posted as to the quantity of lead used in this country is as follows: sheet lead, 18,000 tons; shot, 20,000 tons; lead pipe, 40,000 tons; and for corroding purposes, 75,000 tons. This amount ought to give white lead the post of honor. No other pigment compares with it in use. We have thirty-two corroders in the business; a large proportion of them corrode by the old process, and grind their product in pure linseed oil. A few believe there is virtue in grinding in what is termed water pulp. Pliny, who classed it as a pigment, mentions it among other colors as being liable to injury upon its application to wet stucco. Milk and water mix readily, but it is a great strain on the milk to retain its dignity and color after coming in contact with water. Oil and water do not mix as readily. The less you have in your pigment the better.

ITS APPLICATION.

It is generally conceded that the life of paint is largely due to the pure linseed oil used, and its use should be encouraged. I regret to note that there are a few painters who are lending their influence in the direction of the use of substitute oils in place of linseed oil. It is not my purpose to give you instructions as to how you shall paint or what quality of goods you shall buy. I shall offer a few suggestions which, if carefully considered and carried out, may prove beneficial to the consumer as well as a credit to the parties applying the same. I will touch lightly on the painting of iron, as the gentleman who is to follow me has prepared a paper on that subject. From what little experience I have had, and in coming in touch with parties that have had greater experience, I do not hesitate to recommend the following, referring to painting of iron: The iron should be carefully cleaned off, all loose matter removed, including the rust; then apply a coating of pure boiled linseed oil, which should be well brushed in, that every particle of the iron may be touched with it. When fairly dry the paint may be applied with safety. I have had very satisfactory results from the use of the silicate paints, which have been under test for the past nine years on iron structures, and return satisfactory results to-day. Another combination which has a good record on iron structures is as follows: After cleaning the iron apply the pure boiled linseed oil; when thoroughly dry apply a coating made from two thirds red lead, one third China clay, ground together and thinned with pure raw linseed oil. This formula has proved a great success. In applying paint to iron structures as well as to wood, an important factor rests with the application of the paint, that it is not put on in too heavy coats; thin

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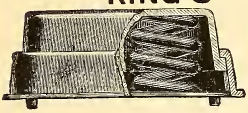

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the coating, carrying all the oil it can, and *thoroughly brush* into the work that no aperture shall be left by which moisture or air can work in and undermine the paint in connection with the rusting of the iron, which destroys the paint. The iron must be protected from the action of the atmosphere to have your paint a success.

THE PAINTING OF PASSENGER CARS.

The great expenses associated with the painting and varnishing of a car and keeping it in an acceptable condition are worthy of careful consideration. Nothing should be neglected. You must have the best talent and the best material in order to reduce cost. The painter should have a roomy building, well lighted, well ventilated, and the heat should be so distributed that no draught of air should come in direct contact with the work of the painter while painting and varnishing, and a uniform heat should be had throughout the room where the work is being done.

Special care should be taken in preparing the wood in such a manner that it will not absorb the oil from the various coatings of paint and varnish that follow. Should you apply the paint and varnish directly to the wood without previously protecting it, the labor would be a failure. The process of producing the foundation is of more importance than is generally conceded. The pores of the wood, let it be hard or soft, must be perfectly closed to prevent the wood from absorbing the oil from the pigments that follow. Vegetable fillers, such as starch and similar products, have not proved a success. A filler combined principally of minerals is the most acceptable. I know of nothing superior to pure silex ; it is transparent, enters the pores of the wood, and remains intact. If the object is to retain the natural color of the wood, great care should be taken that the varnish covers every particle of the work to which it is applied. Much labor can be put into this to good advantage. The rubbing should be most thoroughly done. This helps to fill all the apertures that may not be cared for when the varnish is first spread. This also applies to painting. If there be any neglect, that exactor of all things, the sun, will penetrate, and the storms will beat in, and your paint and varnish are destroyed. The hurrying of painting or varnishing is detrimental. You must not forget that linseed oil, which is used in your paint and varnish, absorbs oxygen, and by this absorption it hardens. One good authority tells me that it requires months for oil to become so thoroughly hardened that it will not change its position. If it takes months to accomplish this, what must you expect from applying coat after coat of varnish or paint every twelve or twenty-four hours? You must give the first or foundation coatings sufficient time to harden to insure best results.

I am willing to concede the general merits claimed for carbonate of lead by its friends, but for a foundation to be followed by colors and varnish I would use a combination of pure lead, pure zinc, and pure silex, one third each, ground in pure linseed oil. This forms a hard and durable surface, and does not sap the oil from either the color or varnish, and you have a longer service in consideration. Cars on the Old Colony Railroad will confirm my opinion. I recall one car painted in 1872, repainted in 1885, the surface then being good. You can afford to use a good varnish over this backing, and the maker will be sought for. The oil in your varnish, as well as in your paints, is the life of each. As long as the oil remains in your varnish it is transparent; when the oil is gone your varnish powders and wastes away, and the paint follows. You cannot be too exacting as to the quality of your colors in oil or japan; it is too expensive to use cheap goods. Do not be misled by making your purchases on price.

I had a call from a party, within a few days, who inquired the price of bronze green in oil. He was surprised at the price that I gave him, and claimed to be a large purchaser. He made the remark that he had just had it offered him at five cents, and wished me to meet it. I declined, for the best of reasons. I had too much self-respect, and too much respect for the party that was making the purchase. I called his attention to the fact that the expense of grinding the pigment, canning, and labelling it would not be less than one and one half cents per pound, reducing the pigment to three and one half cents. When you consider that the cheapest article entering into the green that we would sell is eight cents per pound (that is, the oil), and the other material not less than ten to twelve cents per pound, you can readily see the difference between price and quality.

Do not lose sight of the fact of the wear and tear on the paint and varnish on a car, which is exposed to all extremes of temperature and storms, and fighting the battles against gas from the engine, and cinders which adhere to the car, and in damp weather accumulate and form an alkali which eats away the paint and varnish. The car being hurled through space at fifty miles or more an hour, to stand this pressure your material must be more resisting than iron itself.

HOUSE PAINTING.

House painting means the painting of your station houses as well as your homes. Lord Bacon says, "Useful first, ornamental afterwards." It is stated on good authority that the painting of our houses, particularly brickwork, makes them more healthful. A larger number of cases of consumption are traced to brick houses than to houses of

wood, probably owing to the dampness passing through the brick. A coating of paint or of pure linseed oil would have made them more healthful. Do not haste about painting a new house, or even to prime it until all the plastering inside has been completed and is dry. The exposure of the wood, before painting, to the action of the atmosphere, will bring out all the moisture, sap, and pitch that may be in the wood, thus giving the painter an opportunity to guard against the evil results which would otherwise follow. If you attempt to keep these elements back of your paint, the result will be blistering of your paint, peeling off and discoloration, which mar the beauty as well as the service Light coatings, carrying all the oil possible, are preferable to heavier coatings; three coats preferable to two, giving plenty of time for each coating to absorb the necessary amount of oxygen to remain in its place and render good service. Use your driers as you would use medicine, only in extreme cases, taking advantage of pleasant weather, and when the atmosphere is free from humidity. Select the purest colors possible, when you desire to paint in tints. Allow your paints to be mixed in advance of application a reasonable time, that each particle of pigment may have an opportunity to draw unto itself all the oil it is possible for it to care for.

It is generally considered that the painting of shingles preserves them, increasing their life. I must take exceptions. In painting shingles on the roof of a building, unless great care is taken, the spaces between the shingles are filled with the paint, settling down near the buts, obstructing the natural channel for the water to pass off when storms come, and the dampness is driven back under the shingles, where it remains, destroying the shingles, and the dampness that penetrates to the attics makes them unhealthful. The moisture must go somewhere. If you desire your roofs to have some tinting to make them attractive, use a pure linseed oil stain, which penetrates the wood and does not obstruct the natural channel between the shingles. You need no pigments. These points are worthy of consideration.

In closing my remarks allow me to place before you the following for your careful consideration: —

OUTSIDE PAINTING.

First, for outside painting use the best pigments possible. Be sure they are ground in *pure* linseed oil, also use *pure* linseed oil in thinning same.

Second, never attempt to paint when the work is damp, following rainfalls, heavy dews, or covered by frost; paint with the sun, not opposite.

Third, do your painting in cool weather. By so doing you can carry a larger quantity of linseed oil than you can in hot weather. Remember linseed oil is the life of your paint.

Fourth, do not use heavy coatings of your pigments, but use more coatings thinner and well brushed in, giving time for each coating to dry. By so doing the durability of your paint is extended and looks much better.

Fifth, employ a painter who has a practical knowledge of the pigments used as well as their application. No mechanical part of the completion of your house requires more good, practical judgment than the application of the paints. Good painters are seldom found ready made.

The time has not yet arrived when you can use machinery to throw the various pigments upon your house and obtain satisfactory results.

PRESERVATIVE COATINGS FOR IRON WORK.

BY A. H. SABIN.

It will be necessary for me to talk about what I have done at the South, not for the purpose of advertising, but I want to talk of what I know about.

The way in which this matter of preservative coatings for iron came to my attention with special force was this. Our firm was consulted a couple of years ago with regard to a preservative coating to be applied to a new water main in Rochester, N. Y. This was a thirty-eight inch steel pipe, fourteen miles long. We advised the engineer in charge that the only way in which he could preserve that pipe, with a prospect of permanence, was to dip it in baking japan and bake it. A thirty-eight inch pipe is a pretty big one to handle, but they were having such a terrible time with their pipe it was a matter of desperation, and they resolved to do what we advised. The result was very satisfactory to them, and attracted a great deal of attention. The coating we applied to that pipe was a special baking japan, made expressly for the purpose, and differed from the ordinary baking japan. An oven thirty-five feet in height was built so as to allow the sections of pipe to be put in in a vertical position, in order that they might drip properly. That was the beginning of our applying the preservative coatings on a very large scale. We had been making baking japans for fifty or sixty years, but work on such a scale as that had never been undertaken before.

Now, what I have to say is based upon that and upon the prepara-

tion of ordinary air-drying coatings, which are required to supplement that kind of work, and used for painting bridges and other structural work, not fine finishes, not what you would call black rubbing japan, but simply preservative coatings.

Permanent preservative coatings for iron belong to two classes: in the first the coating is made hard and firm by a process of baking; in the second it becomes hard at ordinary temperatures by oxidation, or by evaporation of a solvent, or by a combination of both these processes, or in some cases by mere cooling from a heated and fused condition. We will consider these in order.

The first class consists of enamels and of japans. Enamelling may be briefly described as a process of covering a metal with a glaze essentially similar in its constitution and properties to glass, and possessing all the advantages and disadvantages of that substance; the glass is melted by intense heat on the surface of the metal, to which it adheres. The process is rather costly, and the coating thus obtained is very handsome and resists the action of solvents well, but is brittle and easily chipped off. Japans are intermediate between enamels and ordinary varnishes. A properly japanned surface has a power of resistance to solvents approaching that of an enamel, while it greatly suapasses that in the tenacity with which the coating adheres to the metal, allowing the latter to be hammered and bent, and its elasticity is in most cases greater even than that of a varnish. It is also intermediate between a varnished surface and glass in hardness, being harder than gypsum and as hard as marble. As a rule japans are black in color, with a very smooth and apparently polished surface. The black japans are made up of asphalt and linseed oil as a base, mixed with more or less copal resin, usually Kauri, and thinned with turpentine. It is true of them, as of varnishes, that the more linseed oil they contain and the less driers (oxides of lead and manganese) the more durable they are; but in order to get them to bake hard at a comparatively low heat the proportion of oil is frequently decreased as much as possible and the amount of driers is increased.

When a film of linseed oil is exposed to the air it rapidly hardens by the absorption of oxygen from the air. This process leaves the film full of minute pores; hence this film, while durable, is not a good protection, because it is not continuous. As Mr. Richardson said, you want to put on a good many thin coats, because each coat tends to fill up the holes and pores in the coat which is already dry beneath it. The addition of a perfectly neutral substance in the form of an absolutely impalpable powder — such as lampblack — has a tendency to fill up these pores, and hence the well-known fact that lamp-

black and linseed oil make a paint which will last for a generation; but it is excessively slow in drying for the same reason. Varnish resins are mixed with oil for the same purpose (and for other purposes), and so are the various kinds of asphalt. As asphalt is a substance which consists mainly of carbon, holding a position between mineral oil and bituminous coal, and is very permanent when protected from the air, and as it is, moreover, at moderately high temperatures, a liquid, and dissolves freely in linseed oil and melted resins, it is very well suited for the purpose of hardening and solidifying the mixtures in which it is used. The turpentine is used to dilute the mixture, and is all, or nearly all, lost by evaporation during baking. I see no great objection to using benzine in this way; it is all practically driven off. Benzine hurts the flowing qualities of the varnish tremendously, and turpentine is better in a high-class varnish. Where the work is going to be subjected to great heat, I don't know as benzine does any hurt.

When a piece of metal is dipped in japan, and then baked for several hours in an oven, the hardening, which is usually accomplished slowly at ordinary temperatures, takes place rapidly and more perfectly; the film is kept, during this process, in a semi-liquid condition, and all the pores and inequalities in the coating are obliterated. If there are any minute parts of the surface which were not originally covered by the liquid, these are gradually covered by the hot fluid slowly creeping over and in intimate contact with them; and the result is a film, absolutely and continuously adherent to this metal, hard, tough, and with a smooth and shiny surface, free frem pores or irregularities, and well calculated to resist the atmospheric and other agencies which tend to attack it.

It must be obvious that the resisting powers of such a coating will depend on its composition. The cheaper grades are made with coal tar instead of asphalt, with common resin instead of copal gum, and with benzine instead of turpentine; while a heavy mineral oil sometimes entirely, or in part, replaces linseed oil. These may present as good an appearance when new as the very best japans, but are of inferior durability. I don't know why coal tar should not be as good as asphalt, but we have tried it and have given it up. The making of japans has been studied for several generations, and by long experience the skilled maker has learned what are the most durable constituents and their proper proportions, and also, what is of no less importance, the right way to combine them. Asphalt itself is but a generic name applied to mineral substances of various characteristics; and it is important, for durability and for resisting power, to have the best

materials. Japanned iron sign-plates, door-locks, and latches are well known to have resisted rain and dirt and wind for many years; the value of the coating has, for many years, been well recognized and undisputed; but until recently it has been assumed that it is applicable only to small objects. Now, however, it has been proved that it is applicable to very large work, and that it is an economical coating, easily applied, giving uniform and excellent results.

It is perfectly well known to those who are experienced in such matters that the durability of an ordinary oil-and-gum varnish is greatly increased by baking, is, in fact, increased several times. It is therefore proved that the process of baking is in itself of great value, probably because, as already stated, it insures the intimate adhesion of the covering and the base, the continuity of coating, an absence of porosity, and hard-glazed surface which resists abrasion. In addition to this is the fact that the process of baking enables the operator to use a coating which is much more durable in itself than one which will dry hard at ordinary temperatures; for practical use it is indispensable that a paint or varnish shall dry hard within one or two days, while such combinations of material as require weeks or months to dry, and which are therefore much less subject to change from atmospheric influences, can be used only in a baking process. These compounds we do in fact use for this purpose. It is thus evident that a suitable baking japan, properly applied, is the best known protection for metallic surfaces under all ordinary conditions.

One reason why this coating has never been used on large work is that its use has involved the evaporation of the turpentine or benzine with which it is thinned. This creates an enormous fire risk; not only a risk of fire, but also of explosions. This in itself is prohibitory; and further, the cost of this constituent, which is eventually all wasted, makes it expensive. We believe ourselves to be the first to avoid this difficulty, by making a compound free from any such thing, so that there is practically no fire risk in its storage or use, and the purchaser buys nothing but the very coating material itself. When we consider that this reduces the volume of the japan by about one half, the great saving is evident. At the same time we are able to make a compound having the greatest durability of anything known to us. This was what we recommended and what was used for coating the last half of the Rochester pipe line (fourteen miles of thirty-eight inch steel riveted five-sixteenths inch pipe), which was dipped in our compound, and then put into an oven and baked at a rather high heat, 400° to 600° Fah., for several hours. This plan proved very successful, easily carried out, and economical. The coating that was formed by this process was a

very perfect coating. The chief engineer in charge could not tell after the baking which was the top or bottom. It is easy to tell in a small piece, but every section looked like every other section; they did not have to recoat a single section.

The first part of that line was coated with the Californian "Maltha," a petroleum by-product, a sort of artificial asphalt, in which the pipe was dipped and then removed and allowed to cool. This is a very common practice. The objections to this are, that the mixture ought to be just hard enough and just soft enough, a certain mean sought to be obtained by adding to a harder product a varying amount of one containing more petroleum; but this balance is constantly being destroyed through the continual evaporation of the more volatile part, so that successive sections differ, and their coating, which is a thick and at first a very handsome one, flakes off, owing to abrasion, during transportation, and then the hammering, due to field riveting, and the passage of workmen through and over the pipe, knock off a still larger amount, until finally at least twenty per cent of the surface is left uncovered. In the Rochester job several thousand feet in length of the Maltha-coated pipe had to be scraped and then painted, the original coating proving worthless.

Further, any such coating as this suffers continual deterioration when in use. The more volatile and soluble ingredients are gradually removed, leaving the more solid portions as an earthy coating, which offer, on the interior, a good foothold for fresh-water algæ and other plants and sponges, which gradually diminish the capacity of the pipe. The old thirty-inch main at Rochester has in its twenty years of existence lost about fifty per cent of its capacity from this cause. It is doubtful moreover whether the coating, after such deterioration, affords much protection to the pipe.

The pipe sections are dipped in a tank of this liquid, drained, put into a suitable oven and baked. The Rochester plant has an oven capable of taking twelve twenty-eight foot sections of pipe, each weighing two and one fourth tons, and they got two charges out per day. The pipes were supported in a vertical position, the total height of the oven being thirty-five feet, and the drip was recovered and used again. The coating thus formed is very thin, hence a gallon of the liquid covers a large surface; it is absolutely continuous, protecting iron from muriatic acid, for example, for weeks or months; it is elastic and closely adherent, not being scaled off, even in the coldest weather, under the blow of a hammer; it really forms a skin over the iron. These pipes stood transportation on wagons during the winter without abrasion.

Of course pipe sections are heavy, but with proper appliances it is entirely practicable to handle them. Something has got to be done with them anyway.

I have here some small pieces of steel pipe which were coated in my laboratory with this preparation, and you can see what they are. I will call your attention to the fact that they are extremely tough; you can hammer up a pipe without breaking off the coating. While I don't expect that we are going to see many beams or iron posts coated in that way this year, I believe we are coming to it, because it is just as easy to do it as it is to coat water pipe.

Besides the Californian "Maltha," other coatings belonging to the second class — those which become hard at ordinary temperatures — are ordinary oil paints of various kinds, and certain mixtures more or less resembling varnishes. The oil paints consist of some powdered pigment, usually a metallic oxide or carbonate, suspended in linseed oil or some inferior oil; some of these paints are sold at prices which preclude the possibility of using linseed oil. I know of one paint that is used a good deal, sold at forty-five cents a gallon. These paints are fairly durable, and some of them very durable on wood; but on iron they have not proved to be so, and experience has shown that the metallic oxide acts as a carrier of oxygen to the underlying iron, causing it to rust instead of protecting it. For this reason these paints have been unsatisfactory and to a large extent abandoned. It is well known that linseed oil alone is easily attacked by sulphur compounds, and it is necessary, when a coating to resist sulphurous gases is wanted, to compound it properly with a suitable resinous ingredient. An ordinary oil paint is also more or less porous, and the iron underneath is observed to rust and then throw off the paint. There was a time when nearly all the iron bridges in this country were covered with these paints; but they have almost gone out of use, as the bridge engineers found they did not, in fact, give iron the protection which their successful use on wood surfaces seemed to promise. You all know that good iron paint on a freight car will last about as long as the car will, and that the iron roof painted with the same paint will not last more than three years. I mean plain corrugated iron. Now I think the reason is just this. You know that a piece of iron without anything on it can be kept for a long time under proper conditions; but as soon as it begins to rust it rusts very fast. You have got to keep your tools bright, and your gun barrel, and they are all right; but if you allow them to begin to get rusty, the rust corrodes them very fast, because that coating of oxide of iron acts as a carrier of oxygen to the layer underneath it and oxidizes that, and that the one underneath, and so on.

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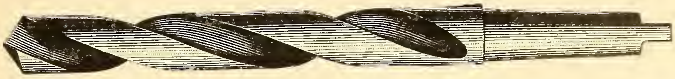

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Now, with this oxide paint you put on a coating of iron rust, and it is the most suicidal thing you can do, and I believe that is the reason why the use of oxide of iron on iron work has so extensively gone out of use. Some have had better success than others; but as you go over the country you see that bridges are not painted with oxide of iron any more, and I think that is the reason.

Greater success has been obtained by the use of varnishes or mixtures intended to be of that sort, fluids, not holding pigments in suspension, but drying either by evaporation or oxidation, or both. Most of these preparations are only mixtures, and are compounded mainly of coal tar, dead oil, resin, and benzine, sometimes with the addition of resin varnish and driers. Especially there has been a practice of coating the hot pipe with coal tar or coal-tar preparations; however good results may have in former times been obtained in England by this method, certainly it is not very successful here; personally, the writer of this doubts if it ever was of much value, but certainly the present methods of making coal tar, so different from the practice of forty years ago, give a product which is sure to change rapidly. It is the common belief of all those most familiar with the subject that anything depending for its elasticity on coal tar or mineral oil cannot be durable, although it may be cheap. As has already been said, no preparation which is used cold is as good as a suitable baked coating; but there are many places where baked coatings are not admissible; for example, railway and other bridges, iron roofs, and in general structural iron work, already in place; also the rivet heads, etc., of field-riveted work; in fact, there is and always must be a great demand for a coating which can be applied by a brush, and which will dry within a reasonable time in the open air. As it is not necessary to have for this purpose a very quick drying substance, we should be able to make a preparation which shall possess very great durability.

It should be made with a pure asphalt, not a cheap grade, but such as is used exclusively in varnishes, and pure refined linseed oil as a base; it should be made by a skilled varnish maker, and be in no sense a mixture; it should be absolutely free from coal tar or coal-tar products, mineral oil, resin, or benzine; it should be thinned with the best turpentine; it should represent the skill and experience acquired during many years as applied to the problem of securing the most durable coating; it should be sufficiently soft and elastic so as not to chip off even under a blow in the coldest weather, and not softened, but rather hardened, by heat; it should not be affected by acids or saline solutions. It cannot be expected to last forever, but it may be

more durable than anything which has been used for the purpose within our knowledge of the matter. It should not dry too quickly, so that it can be applied without skilled labor; it must be perfectly homogeneous, so that there is no waste in using it; it must not depend on heat for its fluidity, so that it may be used in winter or summer; being free from benzine, its storage and use are free from any unusual fire risk. After ten or twelve hours it cannot be washed off by the severest storms, and it is fairly hard and dry in thirty-six hours, although it continues to harden for several days.

Such a coating may give a beautiful black finish, having neither a dead surface nor a high gloss, but resembling, at a short distance, a Bower-Barff oxidized surface, and is very suitable for either exterior or interior ornamental iron work, as well as for heavy structural work.

Varnish is different from paint in this respect: as soon as the turpentine has got out of the varnish, when you put on water it hardens it; when you put water on paint, it tends to wash it off. A properly made varnish, whether made of asphalt or copal gums, is hardened by water, that is well known, and for that reason you can make a coating of this sort which shall resist a rainstorm before it gets dry, and while it is still tacky and partly wet to the finger, it will resist rain because water hardens it. It is not intended to make a smooth surface such as you would get on a panel, but it is a preservative coating. I have here two pieces of iron which have been given each two coats of an air-drying paint, really a varnish. The bridge engineer does not admit that he varnishes his bridges, he paints them, and so to please him we call it a bridge paint; but it is really a varnish, and there is no pigment in it.

I would also call your attention to another point. I spoke of the importance of using a pure, refined linseed oil. It is just as important to use refined linseed oil in black varnish as white varnish. To get the color out of linseed oil is of small importance; the primary object is to get out a non-drying constituent, so that the oil will dry without loading it with driers. There is one thing in my experience in the varnish business which agrees with the experience of everybody else in that business, and that is, that every bit of drier which you put into a varnish or paint hurts it; and what we aim at is to make a varnish without any drier. We have not got to that point yet; and if anybody claims that he has got such a varnish, I should be a little sceptical about it. But in the last ten years varnish makers have reduced the drier a great deal, and have done without it by refining the linseed oil and getting the non-drying part out of the oil. By getting that out you accelerate the drying and improve the durability of your paint. Here are two bottles of linseed oil; one is Thayer's, a good

standard raw oil, and the other is the same oil after it has been refined. I don't know what other varuish makers are doing, because a great many seem to think it is absolutely essential to keep the varnish business a profound secret; no man can go through a varnish factory and carry off the process of making varnish. As far as I am concerned I am pretty free to talk about these things. This way of refining linseed oil, as far as I know, represents the high-water mark in that process. Other people may refine it better, but it is not a commercial article; they do not make it to sell, it costs too much.

The question is asked if the process is a secret. Yes, it is, and if I should tell you what it is, the probability is that you could not do it at all. I don't do all this work myself. When we first put up the plant for refining the oil, I had a man in charge, and we did the best we could to get that oil out, and we never got out two lots alike; and finally I got another man, more intelligent, who seemed to get hold of it, and now we are turning the oil out right along. The process was supposed to be the same, and why the results were not I cannot tell. We use the residuum to make driers, which are made of linseed oil cooked up with litharge, manganese, etc.

Question from the Audience. Do you know what it is chemically?

Mr. Sabin. I know this much. Nobody is going to give a formula for refining linseed oil that will satisfy me as to the constituents; and I cannot give one that will satisfy everybody. It is a very complex and intricate matter. We went to work on some experimental knowledge, and we had some theoretical notions, and we got at these results. You will understand that these oils are the same; one is the other refined.

Now, I am not a varnisher; there are plenty of shop matters I don't know about. All I know about varnish is making it in the factory, but I am willing to answer any questions.

The President. We have with us this evening Mr. Charles Copp, master painter of the Boston and Maine Railroad, and we should be pleased to hear from him.

SOME PAST EXPERIENCES, PRESENT PROBLEMS, AND FUTURE PROSPECTS OF THE RAILWAY CAR PAINTERS' TRADE.

BY CHARLES E. COPP.

Mr. President and Gentlemen of the Club, — It is a pleasure to me at least to see the painters and paint and varnish makers and

dealers have their "innings" occasionally in the deliberations of this Club, which, for the most part, discusses matters that are somewhat foreign to our interests, though probably it may be said with truth that there is a sort of kinship in all things pertaining to a railroad, and some interest is attached to the discussion of any theme in the operation of it to any employee, however distant to his position the subject may seem to be. You have given us a subject to-night broad enough, so that the most rambling of us ought to hit it somewhere. While I have personally no special burden upon my mind which I desire to crowd upon your attention, still, by invitation of your worthy President, I wish to lay before you some matters in the line of painting and varnishing that may be of interest to you, and will speak upon the subject of a quarter-century's experiences in the railroad paint shop, its present problems and future prospects. You will excuse the frequent use of the pronoun "I," as I am speaking for no one but myself.

By way of introduction, it may be observed that there has always been, with all men in all stations of life and degrees of civilization, a certain amount of attraction in the painting business. The aborigines who once stranded their canoes on these shores and with bows and arrows roamed these plains in quest of game, where now these stately streets stand, for want of a better use for certain rude pigments, painted their faces with them that they might make themselves more attractive perhaps in the eyes of the young squaws. This fashion, I am sorry to observe, has not altogether gone out of date down here in the dawn of the twentieth century; its practice has become transposed as it were, that is all. It is the white squaw now who uses the paint upon her face in order to captivate the young braves who perambulate these streets; and many a courageous chieftain goes down under their cunning arts.

Again, all men will agree that the judicious use of paints and varnishes produces a vast improvement upon vehicles of all kinds, as well as the houses we live in, not to speak of the greater durability to these things derived thereby. Indeed, to many, there is a real fascination in connection with the fine effects of surface and decoration that are produced with good materials in the hands of the skilled workman, which is not confined wholly to the ranks of those who follow the trade, but is shared in by others and often by the superior officers on the railroads employing us. One master car builder on a leading Western road, who was at our Buffalo convention last fall, spoke of his interest in this calling, and said that when he was employed on a certain road in the East a few years ago he spent much time in the paint shop studying the methods and materials with which this branch of work is

carried on. And we may be allowed the remark in passing, that if others in a like position would spend more time in the consideration of the painter's difficulties which he encounters, and acquaint themselves more with the tools, methods, and materials he employs, they might perhaps praise sometimes where now they blame. We might get better shops where clean varnishing could be done by having shops with cross tracks in them so that partitions could be put in at intervals, thus making separate rooms for varnishing and shutting out the dirty work, which at present in most shops is all done in the same room with all the rest.

Painting has always been to some extent shrouded in mystery, and it is to these mysterious methods of reaching pleasing results that we owe no doubt much of this fascination. There is always an attraction about anything mysterious, which makes it difficult for some to keep a secret. But in the light of these days, when even "murder will out," it is next to impossible to pride ourselves on the possession on any trade secrets. There are too many hungry editors and readers of trade papers nowadays to keep things of importance long enveloped in darkness. Once the time was when the imitation of fancy woods by artistic graining came into vogue that the secret was kept from the public by closed doors, but now the man who does it needs more to be guarded from the attacks of an incensed clientage than does his method of doing it, so fastidious have people become about natural wood finish and any cheap imitations thereof.

Turning our attention now directly to the railway paint shop as we saw it over a quarter-century ago, and what do we recollect of interast in comparison with the present times? Well, first, let me remark that I am no pessimistic painter gone to seed or gone to den to suck my paws about "the good old times," and to nurse what ills are incidental to all conditions of life. The "good old times" of twisting paint mills and boiling kettles with nameless pungent odors, when the average paint shop was also a paint and varnish factory of the most primitive sort and the rudest character, when we ran, like reindeer, with hot irons from the blacksmith's shop to burn off our paint, or held up a charcoal box with an open grate on one side for the same purpose, offer no special attractions to your humble servant; and he does not propose to weary you at length with the recital of things as they *were*, preferring to deal more with things as they *are* and are likely *to be*. Suffice it to say that I am not one of that number who daily descant on what our daddies did, and as often announce that everything is going to wreck and ruin. Life is too short at best to shorten it by any such needless worriment.

One thing is certain: if the painting that our fathers did was not durable it was not for the lack of time to do it in properly. Who does not know that it took about as long to get a newly painted car through the shop then as it does on an average now to get a new tariff bill through Congress? How they coddled with it until the wheels, unless they had been made of iron, would have become flattened with staying still so long. And when, at last, the car departed, everything looked odd about the premises without it as it does when you move any piece of real estate to another locality. Then, again, it was not for lack of plenty of material that a good job was done. Like the man who bought the boots several sizes too large for him, they seemed to think that the more material the better to put on a car, as it would "preserve the wood." And, we may add, there are those who know no better to-day. And so coats of paint as slow in drying as is a snail in travelling were applied to start with, gradually tapering off well up into the 'teens with coats; and then the remarkable blunder was made of applying a coat of rubbing varnish, or color and varnish, over all this to rub down as a proper surface with which to furnish a safeguard for the mistakes, tumbles, and spillings of paint thereon by sundry aspirants for artistic honors, because it could the better be washed off if daubed or otherwise soiled. And so the good work of the elastic under-coating was injured by this application of a varnish to rub down to get a fine surface which must needs be somewhat rigid and brittle in its nature; and still some think they knew everything and this generation is a lot of upstarts who ought to be spanked and sent home to their mothers and their trundle beds.

But how laboriously and under what disadvantages they accomplished the good results that they did in those bygone days! Let us remember their diligence, their perseverance, their untiring efforts, their industry, and praise them in this, for it is the foundation of much of what we enjoy to-day. They did as well as they knew; we ourselves did as well as we knew a quarter of a century ago. We can do no better to-day than as well as we know; but we are to be blamed in any age, under any conditions, in not seeking to know the best materials and methods with which to do our work; and this reminds us of the old adge, "There are none so blind as those who will not see." Prejudice is the main hindrance to progress in any calling. With what incredulous glances our fathers looked at any new materials and methods of doing work, any innovations, especially any new materials! They held up their hands in horror. Are we any better than were they? Not unless we are more teachable.

But things done under protest sometimes turn out better than our

fears; and jobs of painting and varnishing are no exception to this rule. And so in this way, if in no other, some have been actually forced by circumstances sometimes to take advanced ground with respect to new ways of doing things. It is more heroic to lead the way to victory than to come tagging after with the dilatory remark, "Well, we've got there, haven't we?" Who has not seen a job go to the bad with no sufficient cause, upon which much thought and labor had been bestowed, and another done without much care, even in what he felt to be somewhat a reckless manner, hold out in a surprising way? All of which, with many other things, goes to show that painting, more than any other calling, perhaps, has been a succession of experiments, a groping of our way in the dark, by means of which we have arrived at our present conclusions.

Coming to the matter of the present condition of the trade, we are led to inquire, What has a quarter-century of experience taught us in railway equipment painting? It has taught us to paint a car in less than one half the time that it took us to do it then, with equally good results. Now this statement will strike some as incredible; but I think facts will bear me out. At the Sixth Annual Convention of the Master Car Painters' Association, held in New York in September, 1875, Mr. R. McKeon presented his views on car painting, in which he said: "Twelve weeks should be the time allowed to paint a car, and it cannot be done in any less time to make a good job, that will give credit to the painter and all other parties interested in the construction and finish of the car." He also says: "A first-class railway coach on any of our main roads costs when complete about $6,000. To protect this work the painter expends from three to six hundred dollars. The latter figure will make a first-class job." I should think it ought to. Those of you who know what a car is worth can easily figure up what the loss of that car will be while it is in the shop; and it seems to me that ought to be added to the cost of painting the car. How many railroads in the United States can stand that to-day? In contrast to this I find in the *Railway Car Journal* — in which I have the honor of being a chief scribbler — for December, 1893, an article by the master car painter on a leading Western railway, on Speed and Durability in Car Painting, in which he tells how a car can be painted and ready for service in fourteen days, and for permanence and durability. I offer that to prove my statement of the progress made in twenty years. That is the other extreme, and the painting of cars on that road is all done by that system. Either they are making a serious mistake, or there is something in it.

We must remember that cars so long ago as in the sixties had

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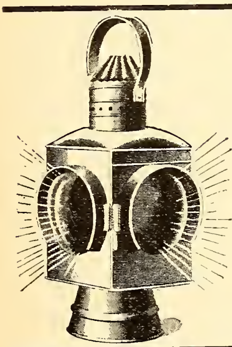

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better care while in service than they do on an average to-day, also with less mileage per day. They were housed then, while now they must stand the trying ordeal of New England weather in all its variety. First, it is below freezing, and our coach panels, which were so recently wet, are now covered with ice and sleet, with all its expansive force; next the ice melts and contraction occurs; now the mercury begins to climb and the paint and varnish to expand again, not by ice but by heat. Then comes the blistering heat of summer, with the added reflected heat of the sand and iron in the railroad yard, until you can scarcely hold your hand on a panel. Is it strange that a climate that sends more than its full quota of human beings to an untimely grave should equally strain all of our work? The dentists, you know, tell us that it is first hot, then cold drinks that destroy the enamel on our teeth. What about the varnish on a car in midwinter that is washed with hot water, as I have known it to be done? I consider, all things being equal, that the average passenger coach of to-day is a compliment in durability to the thoughtfulness of the painter who painted it, and of the care of the manufacturer in producing good materials that can be had if we will pay for the best. I know we cry "adulteration," and the Lord knows there are chances enough to do it, and there is much of it done; but we must also remember that apace with the cunning and craft of adulteration has come the skill of analysis and detection. It was considered respectable to have the itch until the microscope came to town.

Now I need not, time will not permit me to, go into detail in describing just how we have been enabled to do a car so much quicker than formerly. Plainness of decoration accounts for some of it, but we will leave that out of the question, and take the car from the wood up to the last coat of color, and we find the same ratio of rapidity. Not to speak particularly of new systems of priming and surfacing whereby some are gaining much time, not to the sacrifice of durability, — and there is a future field of usefulness for some new materials along this line, — we have in the lead system dispensed with some coats, finding that we can obtain a satisfactory surface with less; and a surface obtained with the least thickness of paint, if properly tempered and applied, any car painter who knows his business will tell you is the most durable. We do mach to-day toward a surface by knifing, — a cheaper and quicker method that has arisen in these years. We letter, stripe, and decorate (if we stripe and decorate at all) directly upon the flat color; and then do what they would not have dared to do much over twenty-five years ago, apply three coats of finishing varnish in quick succession over all without rubbing. We

have, in other words, dispensed with rubbing varnish on car exteriors, except in some cases perhaps to mix in a little with some finishing for first coats. This "repeating process," so called, in car finishing is, I consider, one of the most important steps toward more durable painting that has been taken in all these years.

Then our prejudice against a dark body color is breaking down. Why? Because we find we can keep up an equipment with less accumulation of pigment upon its surface; and less paint always means less cracks and more durability. Some are disturbed because they observe that dark-colored cars do not hold up the lustre of the varnish so long as did the light. I will admit that there is something good in a lead foundation for varnish, and something bad in a dark color to draw the sun which destroys our varnish, but the greater part of this trouble, I think, lies in the fact that a dark color shows up both the lustre or dimness of varnish to greater advantage or disadvantage, as the case may be, than does the light. You notice, therefore, any change that has taken place upon its deep, mirror-like surface more readily because it is more noticeable. Anything that has happened to mar the surface of a mirror you would notice at once on entering a room, while an equally smooth and lustrous surface with a different background you would not notice imperfections upon so readily for the same reason.

Many of these improvements in car painting, in addition to what I have noted, which I cannot stop to name now, are due to the noble work of the Association of Master Car and Locomotive Painters which meets yearly for the discussion of improved methods and materials for this work; and I cannot and I should not do well to refrain from mentioning it. Those of you who have foremen painters under you should not wait for them to ask you for the privilege of attending these yearly meetings, but you should, as the Pennsylvania road did last year, notify your men to go when the time comes, assisting them in the matter of their transportation and giving them their time, if you cannot guarantee them their hotel bills paid, telling them what you expect of them in return.

Lest I weary your patience, if I haven't already, let us now with a passing thought turn from the present to the future. The success of the future depends largely on how we discharge the problem of the present. We have new systems of painting before us, and will be continually having materials to test that are new to us, and we must be ready to try them, or leave them to our successors to try after us, and read the praise of it and give us the blame for being "old fogies." This is a world of progress which must take hold on every calling.

Everything has got to go together or, to use a homely phrase, "something must bust." If I did not believe there was any chance for improvement in the painting business in the future, I should lose heart and would fain "be an angel and with the angels stand, a crown upon my forehead," but with *no paint brush in my hand.* Perhaps I am too optimistic in my views, but the progressive side is the bright side, and that is the side for us to look at if we would succeed.

I thank you for your attention, and beg pardon if I have trespassed too much upon your time. This is a broad subject, which I have even in this lengthy talk merely outined.

The PRESIDENT. We have with us this evening one who was an associate of the speaker for about eighteen years, summer and winter. He used to be known as "Bill Hibbard," but I will introduce him to you as Mr. William E. Hibbard, foreman of the paint shop at Allston, under Mr. Adams.

PAINT AND CAR PAINTING.

BY WILLIAM E. HIBBARD.

Mr. President and Members of the New England Railroad Club, — The subject of paint and car painting is a very important one, and I wish I had the ability to do justice to such an important question. But with an experience of twenty-five years, I think, without being egotistical, that I know a little about the practical part of car painting, although I have not the ability to stand up and talk about it in public, and cannot put in writing what I would like to say in regard to it.

During these twenty-five years I have seen a great many changes in car painting. The tendency years ago was to turn out a first-class job regardless of cost, and we used to do it. Now the thing is reversed, a fair-looking job, durability and cost considered. Now, Mr. President, the ingredients that enter into car painting are many, namely, lead, oil, turpentine, japan, coloring material, and varnish; and it is important that all of these should be absolutely pure, in order that a good, durable job may be turned out. Do we always get them so? I think not in all cases. Then the question would naturally be asked, Cannot you as master painter detect the adulterations? I would answer, not always, as the manufacturers are too smart for us; they have got their business down too fine, and only by an expert chemist can their fine work be detected.

I know a master painter, with a big reputation as such, who also pretended to be quite a chemist, who had two samples of white lead sent him for analysis, and for him to pass his judgment upon as to their

purity. He did so, and the very lead he picked out as absolutely pure contained the largest amount of adulterations.

The master carpenter picks out his lumber; he can see at a glance if it is wormy or sappy, or whether it is clear and well seasoned and fit for the job he has to do. Not so with the painter. So you see, Mr. President, it is absolutely necessary for each and every one of the many ingredients a painter has to use should be of the very best quality. Such being the case, and a reasonable time given to do the work, I can see no reason why a car turned out of the shop under those conditions should not look well, wear well, and give general satisfaction. Now we paint a car in January; the painter has steam heat in his shop by which he can keep the temperature up to seventy-five or eighty degrees, night and day. He turns that car out; it looks well, runs seven or eight years, and gives good satisfaction, of course being revarnished each year.

In February he paints another car under the same formula, the same painters do the work, the same temperature is in the shop, and there is the same time to do it in, the only difference being that a new lot of stock has arrived in the shop with which this car is painted. The car is done; it looks as well as the other, runs the same number of miles, is taken the same care of, but does not wear as well as the car done the month previous.

In fact, the first car looks better at the end of six years' service than the other car does at the end of four years' service. What is the matter? Something must be wrong that there should be such a difference in the painting of cars. Surely the elements or weather can have nothing to do with it, as I contend that a painter has not that to contend with in cold weather, if he has steam heat and can keep his shop up to seventy-five or eighty degrees. The elements do not come in at that season of the year; they come in dog days, and in damp and wet weather, when he has no steam heat at his command. I ask again what is the matter? Mr. President, I think I know, and I think every gentleman present knows. Give us in all the many ingredients we use pure stock; don't buy of Tom, Dick, or Harry because his stock looks as well, and because you can get it an eighth of a cent a pound or gallon cheaper; get us good stock, do that much for the painter, and I guarantee that he can and will be only too glad to turn out a job that will be a benefit to the railroad companies, a credit to the master car builder, a credit to himself, and a satisfaction to the men that do the work. I mention this merely to bring out discussion on this subject. I know this experience has happened to a great many painters, if not all of them, and we want to find out, if possible, the reason why there

is such a difference in the durability of cars, and if it is not possible to obviate the cause. Believing there are other gentlemen present who have papers to read or remarks to make which will take up the evening, and knowing that where there are too many questions to talk on we bolt through them, and do not give them the consideration they demand, I will not trespass on the time of the Club any longer.

Mr. Kent. If there is to be any more discussion on this subject, I would like to be informed, if it can be ascertained, — not for my own benefit, but for the benefit of my brothers in the supply business,— what the ingredients are of the paint used in painting a town red. (*Laughter.*)

The President. I think we shall have to refer Mr. Kent's inquiry to Harvard.

Mr. Hibbard's paper brought to my recollection a little incident which I will relate, in connection with the adulteration and analysis of paint oils. Away back in the early seventies, when my brother was master car builder at Allston shop, he was using a certain oil, and it was all wrong. A fellow came there one day who said he had the stuff to use, that his was a much better oil, it was purer in every respect, would go further, and was just what we needed. We had previously bought a barrel of this same oil he was trying to sell us, and my brother thought he would have them compared. So he told me to go down and draw a bottle of the oil we were then using and a bottle of the other kind. I took two bottles, and, not being so sedate then as I am now, I thought I would experiment a little on my own hook. So I drew two samples out of the same barrel, the one containing the kind of oil the man was trying to sell to us, and labelled one bottle as containing that oil, and labelled the other as containing the oil we were using, which had proved so unsatisfactory. The two samples were given to him for examination, and in about two weeks they were brought back with a long document to the effect that the oil he had to sell was pure in every respect and of high quality, and the other was good for nothing, being very much adulterated. That taught me a pretty good lesson as to the comparative value of oils.

We are honored by the presence of some of our Boston officials to-night, and I have no doubt that the members of the Club would like to hear something from them on this subject. I have great pleasure in introducing to you Mr. Robert C. Fitch, Chairman of the Board of Fire Commissioners of the City of Boston.

Mr. Fitch. Mr. President, I think I am perhaps tall enough to speak without getting up on the platform.

Gentlemen of the Club, I am almost totally at a loss to know what

to say on this occasion, because I did not come here with the expectation of saying anything. The business which you represent, or the allied kinds of business, is something with which I am wholly unfamiliar, except as all laymen are supposed to know somethlng about the various professions and trades. But I must say that I have a very great respect for the painter's art. It took a great many thousands of years for the Creator to bring the world into the condition in which we find it to-day, as pleasant and beautiful as it is, and the finishing touches were those of color. We hear of no human inhabitants of the earth until the Garden of Eden appeared, I believe, and the conspicuous feature of that Paradise was its color, — green grass, red roses, an infinity of bloom and leaf, etc. So we must look upon the painters as the physical perfectionists of the earth as they are to-day. We have mora perfectionists, but it was left for you, gentlemen, to put the finishing touches upon what the machinist, the carpenter, the cabinet-maker, and all that clas of artisans who come before you, produce. We can build an engine that will work very well as it comes from the blacksmith's shop and the wood shop, but it is entirely unsatisfactory to us until it pleases the eye. The Fire Department was trying an engine to-day in one of the city yards. It was a very practical machine, and satisfied our expectations; but if it had been without the red which the gentleman spoke about a few moments ago, and had not been touched up with a little gold, etc., we should not have accepted the engine. Everything of this kind has to pass through your hands before it is accepted.

The idea of saying anything here this evening was very remote from my mind. I came here as a learner. I enjoy coming here and meeting with gentlemen who are skilled in matters of which I know nothing, and hearing them relate their experiences and instruct us from the sources of their wisdom. I am very grateful to you — I cannot say for calling me up — for your kindness, and thank my friend Mr. Richardson for inviting me here.

The President. We have with us Mr. George H. Innis, of the Fire Commissioners, from whom we should be pleased to hear a few words.

Mr. Innis. I am in the same box with my colleague. I asked him before leaving the office if we had got to say anything, and he said he understood from Mr. Richardson that we were to come to learn what would be of benefit to our department in painting our houses and apparatus. We expected to have our painter here to-night, who paints our engines and wagons, but he was not able to come; if he had been I think we should have learned something from him. I am obliged to you and Mr. Richardson for inviting me here; but I prefer to listen to others rather than attempt to speak myself.

The PRESIDENT. I have great pleasure in introducing to you Mr. John R. Murphy, Commissioner of Underground Wires.

Mr. MURPHY. I was informed you were going to have a talk about paint to-night, and I understood something was to be said in regard to a new paint to be used in connection with electric wires, and for that reason the kind invitation from Mr. Richardson brought me here. I have not heard anything about that kind of paint, and perhaps it is in the same position as the red paint to which allusion has been made. Before I had charge of putting the wires underground I was connected with the Fire Board, but I never had anything to do with paint. All I can say on that subject is, that I have learned something to-night, and passed a very pleasant evening, and I thank the gentlemen of this association for it, and Mr. Richardson.

Mr. MARDEN. I want to say one word. I think we have made no mistake in our subject for this evening, but I see that we have only made a beginning to-night. I know that there are quite a number of our master car painters who are prepared to say something on this subject, and I know we are all interested in this matter of car painting as well as car building. I would like to hear something in regard to the details of the work of the various master car painters in bringing up a passenger car from the point where the carpenters leave it to the point when it is ready to go on the road. And there is another thing which is of much importance to us and to our master car painters, and that is the care of the cars after they leave the car shop, upon which something useful might be said. I was going to suggest that we continue this subject to another meeting, and by so doing I think we can make it interesting and profitable. We have succeeded in drawing out some of our friends, and I think we may well continue the subject.

Mr. F. D. ADAMS. I quite concur in Mr. Marden's proposition. When this subject was first broached, I was rather opposed to it; I was fearful that much would not be said upon it; but I have been very much interested in what has been presented, and I have learned something; and I think, as our master painters have not had much of an opportunity to give their personal experiences, and discuss this question, after hearing the papers which have been read, it seems to me it would be well to continue this subject at our next monthly meeting. I will second Mr. Marden's motion, if he will make it a motion.

Mr. J. W. MARDEN. I will make it as a motion; and I will add that we have with us a number of varnish makers, and what we want is to find the best varnish and the way to apply it, so that it will stand two years of service; and I think some one of our varnish makers could submit to us a varnish that will do that.

The motion of Mr. Marden that the present subject be continued to the February meeting was carried.

Mr. Willard Tyler. As this subject has gone over to another meeting, I will tell a little story in connection with this matter of paint, varnish, and the total repairs of cars. I was talking with a master car builder recently and I said to him, "Are you doing much repairing now?" "Yes," said he, "considerable, but it does not cost much." "What are you doing?" said I. He said, "When a car comes in for repairs we paint it and put on a coat of varnish and send it back, and the patrons of the road take it for a new car." I will mention a little incident that came under my observation, in connection with a fifty-mile road. I happened to be in the passenger station just as a new car came out of the shop. The road had not much money. As the car came out the president and four or five of the directors of the road appeared and began to express their admiration of the car, which was painted a yellow mud color, and looked quite nice, and I heard some of their exclamations of pleasure at the appearance of the car. "Isn't she handsome?" "I tell you, that is fine!" etc., etc. These officers seemed to think they were looking out for the interest of the stockholders and the travelling public in that way.

The President. I see that Mr. Brown is present, formerly master car painter of the Old Colony Railroad, and we would like to hear a few remarks from him.

Mr. Samuel Brown. Mr. President and gentlemen, it is true I was formerly in the Old Colony employ, and I was in the New York, New Haven and Hartford employ for a short time. Paint, putty, and varnish have been my companions since 1858. I passed about a year and a half in the United States Navy out of that time, but aside from that, paint, putty, and varnish have been my constant companions. Now I have branched into another business, but I am still in the color line; I have a greenhouse and am raising colors. I love to hear this talk about paints and varnishes. To my mind they are among the essential elements in the make-up of the articles and structures to which they are adapted. Mr. Marden's suggestion to carry the discussion of this subject over to another meeting I think an excellent one. I regard the care of cars in service as a matter of the greatest importance; for what is the use of painting a car and making it look nice, unless you take care of it afterwards? The care of the car is as essential as the work put upon it in preparing it for use. I remember being some time ago at a gathering of the Club where painting and varnishing were under consideration, and I think I said then, that if one were to buy a nice suit of clothes and take them home, and take no

care of them, throw them upon the floor, cast them into a corner, and subject them to other ill usage, how long would they look well, or how long could they be worn? It is the same with wood and iron; when they are nicely painted and varnished they need to be cared for and protected.

The methods used in painting to-day are vastly different from those employed in 1866, when I went on the Old Colony road. To-day the work can be done in much less time, and be equally durable; there has been great progress made in that line. The Car and Locomotive Painters' Association has done wonderful work in reducing time and producing durability.

The PRESIDENT. We should be pleased to hear a few remarks from Mr. George H. Worrall.

Mr. WORRALL. I have prepared a brief paper, which I will read: —

PAINTS, PAINTING, AND VARNISHES.

BY GEORGE H. WORRALL.

Mr. President, and Gentlemen of the New England Railroad Club, — As the subject for discussion this evening is painting, paints, and varnishes as applied to railway equipment, it ought to call out the painters, providing they want to get a chance nearer home, for here we can get nearer our master car builders, and that is one step nearer than we can get in our conventions, for our master car builders are not there, and we are not so afraid to let out, but we have to be more careful here. I hardly know what the full meaning of the question calls for at the time of writing this, but I do know it calls for something that I and a great many others are every day dealing with.

The paints we are using at the present day are not all that they should be, and what makes that condition I am unable to say. Others are of the best, our ornamental colors, that is to say. Our last coats, before striping, lettering, and varnishing, which we are using of one or two makes, are as good and reliable as can be manufactured; but some of our other colors, such as yellows, umbers, siennas, blues, and greens, are very poor, and really not worth the time and cost of getting them, let alone paying anything for them; and why paint manufacturers will make poor colors and sell them to a railway company is more than I can understand. However, such is the case. I will not say all the colors are poor, but some of them are.

In regard to varnishes, there are made in this country at the present time carriage and car varnishes, and they are two very distinct articles.

A good and what is termed reliable carriage varnish is not good for a railway car, because it has not the body that it should have; and another thing, it does not get the wear that it does on a railway car.

We have always been taught and always have believed that linseed oil was the foundation of all varnishes; but it has been my lot recently to try a varnish altogether different from that, a varnish made of cotton-seed oil, and I must say it was a surprise to me, for it worked fairly well and dried, but how it will wear I am anxiously waiting and watching to see. I am preparing some panels to hang out at my shop, both with that and varnish made of linseed oil.

I have brought a small vial of the oil that was given to me, if any of the painters want to look at it.

The maker of the varnish was at the shop when I varnished the car. There were some faults with it, but he said he could remedy those; but as it is, I would not like to recommend it to all railway shops. I will say that our other varnishes are all right, and will give satisfactory results if applied properly, and time enough is allowed for drying between coats, and after the last coat is on time enough before going into service. There is dissatisfaction when too much hurry gets into a shop, — dissatisfaction and detriment too.

Then it wants good men to work it, that is, to put it on, and here comes the rub. Good varnishers are born, not made. A man can go into a shop and see a good varnisher at work, and will say or get the notion, "Why, I can do that, it's easy enough!" But, lo! when he takes a brush and a pot of varnish and goes at it, it looks no more like varnishing than anything in the world; and no maker can make varnish for that man.

But take a good quality of car varnish of to-day, and a good practical varnisher and proper time, and you will have all that can be expected, and a good wearing and lasting job.

Adjourned.

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PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, Feb. 13, 1895.

THE regular monthly meeting of the Club was held in Wesleyan Hall, Boston, at 7.30 P. M. Vice-President L. M. BUTLER, of Providence, occupied the chair, and announced that the discussion of the subject which was opened at the January meeting of the Club would be continued on the present occasion, viz., "Painting, Paints, and Varnishes as applied to Railway Equipment," and that a paper would first be presented by Mr. de Fremery.

LUCOL.

By JAMES L. DE FREMERY, President and General Manager of the American Lucol Company, New York.

Mr. President and Gentlemen, — I felt at first some hesitancy in accepting the invitation of your President to read a paper at this meeting on the subject of Lucol, because of its importance and the impossibility of going into details and doing it justice in the short time at my disposal. It then occurred to me to aim at giving a general idea of the subject; and I shall feel satisfied if I succeed in making perfectly clear what lucol is, what its characteristics are, and to what uses it can be put.

Broadly speaking, if a new article appears, it is given the credit of being as good as any other article of the same class, until the contrary has been proven the case. Not so with a paint oil. Since time immemorial, linseed oil has been regarded as unique in its adaptability for painting purposes. As a consequence, all new paint oils have been termed substitutes. As applied to lucol, this is at present only partly correct, for the two oils are of a different nature; there are some uses of linseed oil to which lucol has not yet been adapted, as, for instance, varnish making.

There is a certain odium attached to the word "substitute." This is not astonishing when you come to paint oils, for have not all so-called "substitutes" failed? Why have they failed? The reason is apparent. Nature's resources have been very thoroughly explored. Linseed oil was the only oil that could be produced in sufficient quantity, at a reasonable figure, and that possessed the characteristics of a good paint oil. All substitutes were mixtures of known oils, or of one such oil with some cheap, well-known varnish gum. Naturally, they were inferior to linseed oil, and their usefulness could perhaps be measured by the proportion of that oil contained. Adulterating linseed oil with mineral oil or rosin oil is a mere stretching out of the linseed-oil gum at a sacrifice of durability. It is the elastic gum that oxidizes out of linseed oil which makes it valuable as a paint oil. Lucol also has such a gum; but it is more durable than the linseed-oil gum.

When you think of lucol, forget the word "substitute," and you have advanced a great step towards a correct appreciation of the oil. On the other hand, you should remember that lucol is not a cheap oil, and is not offered in competition with such.

Chemistry has done much for mankind. The genius of this century has not knocked in vain at its doors. With its assistance many problems which had baffled the investigator have been solved. Substances are now produced which are not to be found in nature, and others, found in such small quantities as to be very expensive, are manufactured; built up from their component parts, on a large scale; as, for instance, ultramarine. This was formerly obtained from *lapis lazuli*, a precious stone, and was worth its weight in gold. Now it can be had at from three to fifty cents per pound.

As with the pigment ultramarine, so with the paint oil, lucol, both are the result of chemical research. .

What is lucol then? Is it a mineral oil? No; it is not. Neither is it a vegetable oil, nor an animal oil. It is a *manufactured oil*, built up synthetically by a chemical process. The word *lucol* is a con-

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traction of two latin words, *luceo*, to shine, and *oleum*, oil, and therefore means "shining oil."

You all know that when substances or liquids are mixed, there is no rise in temperature unless there be a chemical combination. A rise in temperature is a sure sign of a chemical combination: in some instances the reaction is so violent as to amount to an explosion. The substance produced by such a chemical combination is always different in physical properties from any of the materials used. Let me illustrate.

I have here a grayish black substance looking like some decomposed rock. It is calcium carbide, which is now being produced on a commercial scale by the fusion of lime and carbon in an electric arc furnace under the Willson patents. Here is some water; I pour a little on the rock. You hear a sizzle. The water and the rock combine; a gas is formed. Let us apply a lighted match. See what a beautiful flame is the result! I am producing gas from that rock, or out of the water, as you please; for see, if I add more water, the flame becomes fiercer. The water and calcium carbide combine. Lime is produced on the one hand, and on the other acetylene gas, which burns with a flame said to have ten times the illuminating power of twenty-five-candle gas, and costing per candle-power only half as much. Until this last year it has been impossible to produce this "substitute" gas on a commercial scale, while to-day many experts think the gas business will be revolutionized thereby. Certainly the acetylene gas does not contain that rock nor that water; it is very different from either in physical properties.

Now we shall return to lucol. Animal fats and oils are composed principally of olein, stearine, and margerine. We extract the olein. This is carefully refined, and by a special and partly secret process, using chemicals nowhere else in the world prepared on a large scale, it is converted into this brilliant, transparent, lemon colored oil. As with the acetylene gas, the lucol which results from the chemical combination or reaction is very different from the materials used to produce it.

There are all sorts of rumors in circulation regarding lucol. Some say it contains benzine, others a varnish gum; many insist there is rosin in it, or fish oil, or rosin oil, or a powerful drier, etc. It is very plain that it contains none of these. Seven years ago, lucol was unknown to the scientific world; it has a distinct chemical composition of its own; it is *lucol*, and nothing else.

The characteristic features of lucol can be best appreciated by comparison with linseed oil.

Lucol is more durable than the latter.

It covers as well with from one third to one half less pigment.

It sets sooner, and is therefore sooner dust free; it also dries quicker.

It resists the action of alkalies and acid gases better.

It gives a purer white with white lead.

It preserves the original tints of the pigments longer.

It is not washed off if rained on before dry.

It fills the pores of the wood better.

The initial gloss of lucol paint is not as brilliant as that of linseed oil; it has a softer glow. At the end of from one to three months, depending on the exposure, the gloss of the two oils is equal; after that, the linseed oil rapidly deteriorates, while lucol retains its gloss for many months.

Lucol paint can be flatted with a much smaller proportion of turpentine.

The boiled lucol dries more rapidly than the raw lucol, just as with linseed oil.

Linseed oil mixes perfectly with lucol in all proportions. As a matter of course the addition of linseed oil lessens the good effects of the lucol, and such adulteration is not to be recommended.

Lucol has outlasted linseed oil in all varieties of climate,— in Alaska, in the Hawaiian Islands, in Arizona, in California, and on the Atlantic seaboard, — the longest exposures extending over a period of seven years.

Why does paint made with lucol wear better than linseed-oil paint?

1. The main reason is doubtless that it retains its elasticity so much longer.

2. Lucol gum is not destroyed by alkalies, such as ammonia or lye, and is much less affected by acid fumes or gases.

3. As the first coat fills the pores of the wood or brick better, there in not so much oil absorbed from the subsequent coats, thereby diminishing the danger that the paint will crumble.

4. In painting done with lucol, there is more oil used, and oil is the life of paint.

5. White lead, if pure, consists of lead carbonate and lead hydrate in varying proportions; the best is said to contain seventy-five per cent of the former and twenty-five per cent of the latter. No less an authority on painting than Charles L. Condit writes: —

"Carbonic acid lead produces some change in linseed oil: it makes it into a sort of emulsion. . . . It may be that carbonic acid of carbonic acid lead unites in some way with oil. In any case it is the

carbonic acid lead which makes the paint white, and which causes it to powder."

A further reason for the greater durability of lucol paint lies doubtless in this very point, namely, that the lucol is not affected by the carbonic acid of the lead.

You see here a ball of lucol gum. It is the gum which dries out of the oil. Note how elastic it is, how it bounds.

In these little bottles I have, respectively, petroleum, benzine, ether, and carbon disulphide. I will put a little piece of lucol gum in each; you will perceive that it is not dissolved: it is practically insoluble.

These bottles contain ammonia, potash, concentrated sulphuric acid, and nitric acid, and in each a piece of lucol gum. The lucol gum is not destroyed, showing what great resistance it offers to destructive agencies. Linseed-oil gum quickly goes to pieces in alkaline solutions. Not so the lucol gum, and this accounts for its staying powers on the seacoast, where the paint is subjected to the action of damp salt air and fogs. This quality also makes lucol especially adapted for the painting of boats.

These two boards have been painted, one with lucol, the other with linseed oil, each two coats, using white lead as a pigment. I will pour some strong ammonia on each, and in a short time they will be passed around. You will see that the ammonia has already destroyed the linseed-oil paint, while the lucol paint is unaffected. These two pieces of sheet iron are covered, one with lucol and the other with linseed oil; these small pieces of board, with lucol paint and linseed paint. We will suspend them in this glass containing strong ammonia. In from five to fifteen minutes the linseed oil and linseed paint will be eaten off. The lucol oil and lucol paint will remain unaffected. This feature might be taken advantage of by washing boats, cabooses, etc., with an alkaline soap or with ammonia water, thereby removing the dirt, and perhaps saving a coat of paint. A weak lye might be used for this purpose, but it must be remembered that a strong potash solution will attack white lead.

Here is an excellent illustration showing how lucol preserves the original tints. This board was painted eleven months ago, two coats of English vermilion and lucol, five pounds of the color to the gallon. The lower half of the board was covered with paper, and it was then hung in an exposed position where it received the sunlight for perhaps four hours during the day. You will note that the tint is little affected, taking the length of time into consideration. Vermilion and linseed oil, under similar circumstances, will turn black in a very few months.

As an illustration of the spreading and covering power of lucol, I will site the gable end of the Imperial Hotel in New York. Fifty-five thousand square feet of surface was given two coats of lucol paint of old ivory tint. One thousand six hundred and ninety-two pounds were required, that is, twenty-seven one-hundredths of a pound to one square yard, two coats. Master painters in our locality, in estimating such work on a linseed-oil basis, figure on one half pound of paint to one square yard of surface, two coats, which is a saving of forty-six per cent in favor of lucol.

Here is a small piece of galvanized iron which has been twice dipped in a paint of lucol and white lead. This other piece was twice dipped in linseed oil and white lead ; there is practically nothing on the latter, the paint would not hold. This piece was painted with linseed oil and white lead while lying in a horizontal position ; it was then placed in a vertical position ; the paint has run badly.

Lucol paint adheres firmly to the surface on which it is put ; and for this reason, also because of its durability and elasticity, it is especially adapted for painting on iron.

Painters dislike to paint new galvanized iron, because the paint does not adhere well, and deteriorates rapidly. They believe that the acid in which the iron is dipped before treatment with zinc has some detrimental action on linseed-oil gum. I make no comment. Lucol is apparently not affected in this way, as witness the Starin shed at the foot of Cortlandt Street, New York, which was painted two coats of lucol paint some eight months ago. The structure projects out some 800 feet into the Hudson River. It was new, and the galvanized iron fresh and bright. An area of 171,000 square feet was covered, two coats, by 6,047 pounds of lucol paint, composed of 318 gallons lucol, 3,272 pounds Atlantic lead, 392 pounds color.

Regarding this pier, Mr. Arthur S. Barbier, in his paper on "Is there a Substitute for Linseed Oil?" read before a recent meeting of the New Jersey State Association of Master Painters, reports : "The paint was in an elastic condition, and looked far better than linseed-oil paint would have done under the circumstances. The situation was trying."

The above shed was painted by one of New York's oldest and most reliable master painters. The same party did the Lehigh Valley Railroad sheds with lucol paint ; and in reply to our inquiry regarding the work he writes under cover of Feb. 7, 1895 : "All this work was done by us during the hot weather of the summer and fall of last year, varying in time (of exposure) from six to eight months, and our inspection fails to note that the elements have affected it in the least.

"It is difficult to estimate accurately the saving in material, particularly pigment, on either of the jobs done by us. That the saving was large in both pigment and oil we must admit; but after an experience of forty years as a master painter, we would not feel safe in estimating on any of these several jobs on a linseed-oil basis for anything less than twice the material above mentioned, and then would consider it close figuring."

Now I have quoted what has been written about the condition of the above work for three reasons: —

1. Because the painting was done on bright galvanized iron.
2. Because of the small quantity of material found necessary.
3. Because of the severity of exposure.

The practical examples here given have been selected from your immediate vicinity, to show the characteristic features of lucol.

If any testimony were required as to the wear of lucol, extending over long periods and under trying conditions, abundance could be furnished from the Pacific Coast; but right here in your midst is evidence as to durability. There are exposures of lucol paint of over two years on the Brooklyn Bridge, on the property of the Staten Island Rapid Transit Company, on the Boston and Albany, the Boston and Maine, the Fitchburg Railroad, etc. Through the kindness of Mr. I. G. Wheeler, master carpenter of the Boston and Albany, I am able to show you these two boards, which were painted two years ago under his supervision, the one with linseed, the other with lucol paint. Aside from the loss of the original tint, the linseed paint shows decided signs of wear, which is not the case with the lucol paint, both the original tint and the gloss being well preserved.

Pigments break up more readily in lucol than in linseed oil, and lucol can be more easily and rapidly applied, but to get satisfactory results two things must be remembered: —

1. More oil should be used with your pigments than you would use of linseed oil.
2. Lucol should be flowed on with a full brush, and rubbed out but gently.

These directions are very simple, and yet this little difference in manipulation is on a first trial sometimes a stumbling block to a correct conclusion, not because of any difficulty, but because the painter is incredulous. He does not add enough oil to his pigment; he thinks it "feels" too thin, and fears it will run on him. Then when he applies it he fears it will not "hold up," and he rubs it out like he would his linseed oil, which is too much. One of the peculiarities of lucol is that it is not nearly so liable to run as linseed oil; it holds up

better; it flows well together, and there is not so much trouble with brush marks; it should be applied more like a varnish.

When we say, "flow lucol on," we do not mean that there never are circumstances where it should be rubbed out. For instance, if it is desired to produce an eggshell gloss, or a flat surface, with the use of the least possible amount of turpentine, or in other words, retaining a good proportion of oil, it can be accomplished by using a little more pigment and rubbing out the paint. Then again, it is hardly necessary to call attention to the great desirability of thoroughly rubbing out the first coat, or rather, *rubbing it in*, where iron that has rusted is to be painted; it is important that every particle of rust should be thoroughly coated with oil. In any case, the rust should first be removed as far as practicable by scraping or brushing with wire brushes.

In general, two gallons more of lucol should be used to one hundred pounds of white lead than is customary when linseed oil is the vehicle; while with dry pigments, such as metallic, use nearly twice as much lucol as you would linseed oil.

During last summer several hundred brick fronts were painted in New York City with lucol. On our recommendation, the paint was mixed five pounds of Venetian red to one gallon of the oil, which is equivalent to twenty gallons to one hundred pounds. In most cases one coat has been found sufficient to fill and gloss, while in but isolated cases were more than two coats necessary to give most satisfactory results.

In house painting fourteen pounds of white lead to one gallon of lucol is the correct proportion when the oil is properly applied. For the first coat the above proportion of thinner should be used, only one third should be turpentine. The final coat, if a gloss is desired, should contain no turpentine and a minimum amount of drier. This proportion of oil and pigment works well with all shades of paint, but if deemed desirable the amount of pigment may be decreased as the depth of color increases. Thus greens, reds, browns, yellows, vermilions, and blacks of reputable make may be thinned with from fifteen to twenty gallons of lucol to one hundred pounds of color. That is to say, where the painter is obliged to use say twelve to fourteen pounds of green to one gallon of linseed oil, lucol requires at most seven pounds, a saving of at least five pounds to the gallon. A good green costs fourteen cents per pound. This speaks for itself.

On wall work, ten pounds of white lead to one gallon of lucol is an excellent filler, and generally stops suction. Second and third coats should be mixed fourteen pounds to one gallon, using part or all turpentine, according to gloss or flat desired.

It is apparent from the foregoing that by an intelligent use of lucol, fully its entire first cost can be saved.

1. There is a saving of at least one third of your bill for pigments.

2. By reason of better covering and filling capacity it is often possible to make two coats answer where otherwise three would be required, saving both labor and material, or one third the entire cost of the job.

3. Because of its superior wear you will not have to repaint so often.

The following letter upon the subject under discussion was then read by the Secretary of the Club:—

BOSTON, Feb. 4, 1895.

MR. JOHN T. CHAMBERLAIN, PRESIDENT NEW ENGLAND RAILROAD CLUB.

Dear Sir, — Having received a pamphlet containing the proceedings of the last meeting of your Club, I was very glad to see that the subject of painting is being looked upon as a matter of some importance, and that the Club deemed it beneficial to have the subject discussed. I also noticed that it is to be continued at the next meeting. I would like to be permitted to suggest a few points for your consideration, in relation to locomotive painting (which I believe was not mentioned at the last meeting), which, I think, are quite important, and which would bear investigation.

The idea has always been prevalent among the generality of the human race outside of the mechanical trade that any one could *paint*, and as for the paint, why, that could be purchased most anywhere, even at groceries, "all mixed and ready for use." Quality was not considered, if it would only "dry quick"; that seemed to be the only important requisite. Now, in regard to the first part of this idea that "any one can paint," he may think he can; but if he can, why is it that we give three or four years of time and labor to learn a trade which any one can practise?

I have found in my experience that one great drawback to our painting department is the almost entire absence of skilled labor; for example, I know of one shop where ten to twelve men are employed, and only one beside the foreman was a skilled workman, the others were men and boys first hired as cleaners. Work increases, and in the rush these men and boys, who nine times out of ten never had a paint brush in their hands before entering the shop, are set at work to do what should be done by skilled labor. In regard to the last part of this idea, I will merely say that the very best article manufactured, be it paint, varnish, or anything else purchasable, is, to my mind, the

cheapest in the end; and there are so many reliable firms of manufacturers of colors and varnishes that it is hardly possible to buy wrong.

Again, not enough importance is attached to the necessary time to be given for paints and varnishes to dry thoroughly between coats. I have seen a job of locomotive painting, where the very best of stock was used, and applied by a first-class workman in every respect, *absolutely spoiled* by the hurrying of one coat upon another, because orders came that "they must have that engine; can't get along without her, just such a day." What was the result? why, in a week's time the steam-dome, chests, and cylinders looked as though they were one grand "holiday," and were ready for a coat of varnish. All such places are very liable to leak when first brought out of repair shop, and whenever they do, and the paint and varnish are not thoroughly dry, if it does not roll off bodily, it will form a series of waves which remind us of pictures in the geography illustrating the different mountains and their heights. The tender and cab present a sorry appearance, full of sand, cinders, and everything in shape of flying dust, and finally waste, which the fireman has used, and in his frantic endeavors to *rub off* some of the dirt and grease which has clung to the varnish has *rubbed it in*, waste and all. Such is the picture, which could all be avoided by perhaps twelve hours more time to dry. Then as the undercoats begin finally to dry, they naturally in the process draw upon the outer coats like a porous plaster; they in turn, not being used to such pulling and hauling, finally give up to the under one, until at last we have a tank and cab whose covering resembles the hide of an alligator, and every crack and open avenue for the elements to play havoc upon, not only the undercoats, but the iron itself.

Another item I deem a very important one, and that is the prevailing custom on some roads, among engineers and firemen who have the care of cleaning their cabs and tenders, to do this "cleaning" with soap and water and *black oil*. I have never had it explained to my satisfaction that black oil is any advantage. I question if any person, having a carriage just out of the paint shop highly polished with varnish, should step into his stable, and seeing his man washing that carriage with soap and water, and then smearing it with *black oil*, whether it would be a matter of any great length of time before he would send him out of his employ. I have known of tenders being cleaned with kerosene oil and tripoli, and then some one wanted to know, "what was the matter with the varnish," or "thought it must be very poor varnish the company was using," etc.

I venture to say that if at the end of each day's run good clean water and plenty of it were used, with perhaps the least bit of soap

applied with a good soft sheep's-wool sponge, then the work thoroughly rinsed with water from a hose or sprinkler and wiped thoroughly *dry* with chamois-skin, we should have better looking tanks, and they would be in condition at the end of two or three years' service to rub, retouch, and varnish, and we should avoid the expense of commencing anew every time an engine is brougat in for general repairs.

One more detriment to paint on tenders I will mention which should be avoided, and that is the "sweating" process, causing rust, and the final result of peeling of paint. I have extended these items further than I intended when I commenced, and will say in conclusion that I wish to show by these few remarks and suggestions, and to impress upon the minds of the manufacturers, the fact that it is not always the fault of the *painter*, and upon the railway companies that it is not always the fault of the *stock*, that results are not always what we would like or what they should be.

Very respectfully,

Albert P. Dane,

Master Locomotive Painter, B. & M. R. R.

The Secretary stated that he had received a paper from Mr. G. W. Lord, master painter of the Fitchburg Railroad, who was sick and unable to be present, and in his absence he would read the paper for him.

PAINTING, PAINTS, AND VARNISHES AS APPLIED TO RAILROAD EQUIPMENT.

By G. W. Lord.

Mr. President and Members of the New England Railroad Club.

Gentlemen, — The subject you have before you this evening for discussion, continued from your last meeting, of Painting, Paints, and Varnishes as applied to Railway Equipment, is a very broad and important one. For twenty-seven years and upwards my clothes have been saturated with the fumes of paint and varnish: I do not mean the same clothes. Still I feel hardly able to come before this intelligent body of men to discuss or throw any new light upon the subject. After hearing the remarks of those able men at your last meeting, men who have had experience in talking and writing up these subjects, it makes me feel somewhat out of place. Not being blessed with that beautiful gift of speech that some are, and being of a bashful disposition, you can all imagine my situation. I must say this society, composed of railroad officials,

are taking the right course in informing themselves of some of the ins and outs that their foreman painters have to contend with, in order to make a shop most profitable. It must be run with system; you must have one part ready for the other, or a clash will result, which means time lost and extra cost. There was a time when the word "standard" was quite common, but to-day that sounds to me hardly up to the times, and it looks not far distant when all of the different patterns, etc., connected with the railroad shops will be marked, in place of "standard," "*changed.*" It is not only so with the many different parts, but it is so with the paints and varnishes we are using. There is something new put upon the market about every day. It will not do to keep in the old ruts, as this is an age of progression, and as the crowd passes by we do not calculate to be left; so we just jump on and get as near the band wagon as possible. There is no department where even small changes are felt as they are in the paint department. We will have one firm's color to-day, to-morrow another. We feel the change. Why? Because the men have become acquainted with the old color, and now they must test the new for drying, matching shade, etc. By practical experience men become acquainted with varnish, so that they will know just how to handle it to get the best results. When varnish has been changed, the same men will often make a bad job that requires washing off. Changing of help is another step backward which cannot be avoided oftentimes, and is liable to occur at any time.

It is a great hindrance to the master painter, as he must take time to become acquainted with the new men and their ways of doing their work. No doubt there are mistakes made by not letting the master painter have more voice at times; at the same time, I personally have no complaint to offer, as I hold the highest regard and respect for my superior officers.

While I do not claim that changing of stock causes all the trouble, I do think sudden changes in the atmosphere play an active part in destroying the beauty and gloss on a passenger coach. At one time I had six panels snap like a pistol shot; they cracked from the bottom to the top, opened one sixteenth of an inch, a clean, new crack, all inside of five minutes from the time the coach went out of the shop. I took a ride over our road one hot day in the summer, when the glass stood at one hundred degrees and upwards in the sun, and the coaches were so hot you could hardly hold your hand on them, and all at once they made a dive into the great Hoosac Tunnel for an eight to a twelve minutes' freeze; and when they came out at the other end of the tunnel they were all wet, covered with smoke and soot, cold as ice; then, *vice versa*, they continued on in the hot sun. I would like to

ask any man if he knows of a paint or varnish that will stand these sudden changes for any length of time, without showing some signs of coming to pieces. The heat in the paint and varnish room should be distributed as near the floor as possible. By the opening of the doors into the varnish room to change cars, which must be done on one of the cold days, your heat is all "gone where the woodbine twineth," up aloft, where we have no use for it; and what cold comes in in the few minutes the doors are open requires half as many hours to drive down again where it is needed, showing that it is very important to have two smaller rooms for varnishing instead of one large room, as many a good job of varnishing has been spoiled by opening the doors to make a change, thereby letting the wind blow in, setting the dust flying all over the shop, many times causing the varnish to pit, etc.; all of which could be avoided by having two rooms suitable for varnishing. There should also be a suitable place for washing the bodies of passenger coaches where the water can pass off and not remain stagnant and wet under the floor all of the time, as dampness is one of the worst things we have to contend with.

There was a time when about every color in the catalogue was required to do a first-class job in a railroad paint shop; to-day it requires but a few in most cases, and it does seem as if these could be made of good quality. I have always noticed in the construction of new coaches the best of material is invariably furnished, never allowing an imperfect piece to be used, either in lumber, bolts, rods, or castings of any kind. If this is carried out in the use of oil, leads, turpentines, japans, colors, and varnishes, there is no reason why our work should not stand its full amount of wear and tear. For coaches that have seen ten to fifteen and upwards years' wear, and have become badly cracked, the only known remedy is to burn off or otherwise remove the old paint before painting. They can be painted over old paint and look passable for a short time, but I believe the painter does not exist who can hide the cracks so but what they will come to the surface in a short time. I have failed to find one. During my twenty-seven years' experience in painting, puttying, and plastering up cracks, I never have succeeded in stopping one yet so but what it would open up and come to the surface again. There is a great amount of time and stock used on the inside of passenger coaches that have from years of wear become badly cracked, that is no credit to the painter or the stock used. Such cars should be scraped and refinished. More care should be used in looking after coaches after they have left the paint shop, such as not washing the bodies in hot water, as I have seen done many times, water so hot you could scarcely

hold your hand in it. Consequently the lustre is spoiled, and then the beauty is gone. Oftentimes lamps turned up too high cause a smoke or soot to form on the lining, which is very hard to remove and not destroy the beauty of the finish, while it is often done by inexperienced help, leaving the car looking worse than before it was touched. All of this work should be done by a competent person, one who not only knows what to do, but how to do it. There should be no running of loaded baggage trucks into the sides and gouging out large chunks, then rubbing on of a lot of wheel grease to make it look like an old scratch, thereby save a setting up by the conductor or other official who might discover it, if left as it was, etc.

When one of these coaches comes to the paint shop, and is cleaned ready for touching up, after looking it over and seeing the gouges, knocks, bruises, scratches, etc., most of them done by carelessness, it is enough to make an old timer turn over in his grave. Once more let me say, it is very important that the stock should all be good, as one poor article mixed with others spoils the whole. Taking into consideration the cost and time saved, the results of wear and tear, rough usages in and about yards and depots, the constant exposure to either the hot rays of the sun or cold blasts of winter storms, without any shelter whatever, compare this condition with the former one when roads were small, with but few coaches and most of those housed, and I believe the painting department of to-day stands on a level with the great army of progression.

President J. T. Chamberlain now appeared and took the chair, and explained his tardiness by saying that he had been in conference with the Arbitration Committee of the Master Car Builders' Association during the day and up to that time. He then introduced Mr. Phillips, manager for L. J. McCloskey & Co., of Boston, who presented the following paper: —

VARNISHES AND THEIR ADAPTATION TO SPECIFIC PURPOSES.

By Alvin Phillips.

Mr. President and Gentlemen, — I assure you that I appreciate the honor and the privilege of addressing this large body of intelligent, accomplished railroad men and mechanics, — masters of the several departments of the business.

I am moved to confess that I feel a little timid about attempting to

take part in your deliberations to-night. It requires courage to face in this way gentlemen who can instruct me upon a great many points relating to the subject under consideration. Many of you, I am sure, know a great deal more about it than I do; but, if it be true, as is often said, that wisdom sometimes lingers on the lips of fools, I can but hope that this hour may be the sometime, and I the fool of the occasion.

The practice of this Club in admitting to membership manufacturers and dealers is certainly an innovation; whether "more profitable in the breach than in the observance," I, as a newly entered apprentice in this Club, am unable to say. It certainly seems that our interests, if not mutual, are relative, interlocking, and interdependent.

Railway men require the best product of the factory and of the shop; manufacturers and dealers, individually and collectively, would have you know that theirs is the best. That's what they always tell you, isn't it? Of course you, in the great goodness of your hearts, believe this. If only one or two advanced such a claim, you might reasonably think it was a mistake, but what everybody says must be true.

Seriously, what we all want is honesty, — honest product of the factory, honest workmanship in the shop. Speaking from the manufacturers' side, let me tell you that competition, keen as a Damascus blade, keen and watchful as a lioness with her whelps, is driving the manufacturer to be honest, whether inherently so or not. It is his only means of self-preservation. Now, what is the result? Why, gentlemen, you are getting better varnish to-day than ever before in the history of the trade. We hear people prate about the good old times, old-fashioned methods and material way back in our grandfathers' day. Out with all of this rubbish! I affirm, without fear of successful contradiction, that this day is the best and the richest in achievement, and the present time the acme of all time. We, the people of to-day, are the inheritors, the residuary legatees, so to speak, of all of the achievements of all of the past. Whether we recognize it or not, this is an age of wonderful progress along all lines of human effort, — progress in science, in art, in architecture, in invention, in commerce, in good fellowship, in mutual trust between man and man.

The great law of evolution permeates all trades and every profession, and so the varnish maker must tax his ingenuity to the utmost to keep pace with the ever-broadening demand for improved products. He must do this or his business will perish of its own inertia.

I would not ignore the experience of the past. On the contrary, I would make that the foundation upon which to build better and climb higher. Out of the dead past comes the living present, with its glorious record of human growth. One common aspiration stirs the soul of

every man who has not lapsed into senility, and that is the desire to win success in his undertakings and climb to the highest. This, in varnish making, means a perfect product, adapted to all of the varied needs and demands of the consumer. We may well doubt if this has ever been accomplished. Think for a moment of the requirements of to-day as compared to those of fifty or one hundred years ago! Of course I do not speak on this point entirely from experience, being something under one hundred years old, if I do look it.

Time was when any good varnish was made to serve a great variety of purposes; much was left to the manipulation of the varnisher. With the broadening of the field, increase of demand and diversity of requirement, the tendency is more and more to specialization. The work of more complete adaptation to specific requirements now falls upon the maker to a much greater extent than in the past.

There is, also, an increase of demand upon the ingenuity of the painter and varnisher; this demand comes in the line of better, more elaborate, more artistic decoration. Hence he has little time and less patience to devote to experimental work with material; that must be adapted by the manufacturer to the required purpose. Right here I might say that there are general principles which must be observed in varnish making, certain well-known materials which must be incorporated into the varnish; but there are no hard and fast lines of procedure, or exact rules that must be followed with geometrical precision. Very much depends upon the skill of the maker. As an illustration, you gentlemen know that a body finishing varnish on railway coaches is subjected to disintegrating forces of extreme severity and of diverse character. It does not at all follow that a varnish that will stand the most severe test of exposure to the elements, such as extremes of heat, cold, frost, and ice, is invariably the best for exterior car finishing. Not at all. There are other destroying forces far more severe. I allude, of course, to the gases and vapors generated by the combustion of coal which feeds the fires of the locomotive. These are the mailed giants that we must fight; these are the great dertroyers of the product of the varnish makers' skill and of the painters' art. It may be interesting to trace, briefly, the origin and nature of these gases. That black smoke, rolling in murky clouds from the stack of the locomotive, frequently enveloping the swiftly flying train, is largely composed of vapor charged with the most powerful dissolving and corroding gases that exist in nature, gases that, long years ago, in the carboniferous age, thousands, yes, millions of years before there was a man, much less a railway coach, upon the face of the whole earth, were rampant everywhere.

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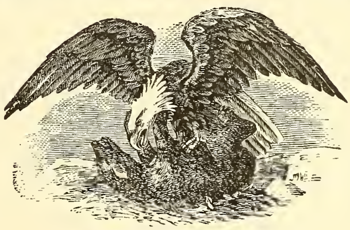
TRADE  MARK.

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These gases were collected in that far-away period, and packed away in the coal beds for the use of man. Frond, stem, and leaf of the rank vegetable growth of the carboniferous epoch absorbed these rank poisons out of the primeval air, and the ancient sunlight contributed its impelling force to aid the growth and fix the gases in the tissue of the plant. Every pound of coal-making, carbon-absorbing vegetable fibre answers to a given amount of solar heat. The ancient ocean, too, lends a hand in the process, and, along with the sinking of continental areas, rolls in over the marshes, burying the luxuriant growth of vegetation under millions of tons of slime and ooze. This buried vegetable growth is solidified and becomes, in the progress of ages, the coal of commerce in general use to-day. The heat which makes the steam to drive the locomotive is yielded by the combustion of coal, which is simply a mass of carbon saturated with some liquid or gaseous or perhaps bituminous hydrocarbon.

There can be no doubt that it was once in the condition of a flowerless tree, rooted, as the late Prof. Winchell well says, in an ancient soil, spreading its green fronds to the old sunlight, absorbing the carbonic acid of the atmosphere and setting oxygen free. I trust I may be pardoned for a seeming digression.

The method of formation of coal is, strictly speaking, a geological science, but it is nevertheless exceedingly interesting and, furthermore, it has a bearing upon the subject in hand, as I will try to show.

When we look at the flame resulting from the combustion of coal, we are apt to think that the material which feeds the flame is destroyed, burned up. Nothing of the sort occurs. Not a particle of it is destroyed; the vegetable tissue simply goes back to its primeval condition; it becomes again carbonic-acid gas, carburetted hydrogen, and the like. These gases, again released, are free to wander about the world, attacking whatever appears, and combining with that which they have an affinity for. The varnish on railway coaches, when in service, is a ready subject of attack by these rampant, deadly, dissolving gases. They deoxidize, soften, and decompose the oil of the varnish, as commonly incorporated, particularly when excessive quantities of oil are used, while the vapors, steam, soot, and cinders complete the work of destruction. It is all important, then, that the varnish maker should understand the nature of these ancient gases, newly released, and their action on his product when under exposure. It is still more important for him to know how to adapt his product to the enormously destructive elements with which it must contend. The old idea was to incorporate in a varnish as much oil as possible.

I believe that is our English cousins' plan and practice to-day. That is all right, so far as weather resistance is concerned, but it woefully fails on the other horn of the dilemma. Weather resistance is one thing; resistance to gases, soot, and cinders quite another and different thing; resistance to the combined destructive force of all, still another and by far the most difficult of accomplishment. These destructive forces are so varied and antagonistic that the varnish maker must enter into all of the details, study the law of cause and effect, and arrange a sort of arbitration, or compromise with the elements, and bend them to his will and genius.

I have spoken of the old idea. The new method, as I understand it, is to incorporate in the varnish a little less oil, perhaps, but have that so rectified by treatment on driers and in other ways as to render deoxidation wellnigh impossible. About eighty per cent of linseed oil is drying oil, that is, dries naturally by the absorption of oxygen when exposed to air, producing a hard, tough, elastic, leathery film, practically waterproof, but not essentially impervious to acids and gases. The balance, or twenty per cent, of linseed oil is non-drying; this, also, takes up oxygen on exposure, but instead of drying, it changes to a lighter or more volatile substance, which is easily decomposed. Now, a varnish under exposure, instead of retaining this non-drying oil, loses it when subjected to heat, either solar or artificial; it is driven into the wood, and, by the action of light and oxygen, is evaporated from the surface. It is the loss of these little particles of non-drying matter that causes, primarily, the destruction of the varnish film, by imparting to it a certain degree of porosity. Through the little pores, thus formed, the noxious gases, moisture, etc., find ready avenues of ingress and complete the work of decay. Careful microscopic examination of a varnished surface in the early stages of decomposition will confirm this opinion. Nor is this all. The incorporation of excessive quantities of linseed oil into a varnish not only makes it very slow drying, but when apparently dry on the surface it does not dry hard underneath; a good railway varnish should dry hard through and through and remain so.

Now, the contrast between weather exposure of railway varnish and exposure by contact with acid-laden smoke, gas, steam, and soot is so marked that the subject of how to overcome the baneful effect of all is well worthy of careful study and painstaking experiment. It is comparatively easy to point out a defect; to discover and apply a remedy, there is the rub.

This is, and always must be, the peculiar function of the varnish maker, and he who best succeeds in this is best fitted to survive.

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The thoroughly skilled varnish maker is guided quite as much by intuition as by experience. He cannot always readily explain why a certain line of procedure yields the sought-for result.

He simply knows that he knows; cannot always tell why, and would not if he could. If he did, the other fellow would know just as much as he. This perhaps explains why varnish men talk all around Robin Hood's barn and say nothing.

With this extremely erudite conclusion, I leave the subject for your individual consideration.

The President. The subject is now open for discussion, and I hope we shall not lack for further information in regard to it. We are ready now to hear from any of the painters who are interested in this matter. I will call upon Mr. Copp, the master painter of the Boston and Maine Railroad, to give us his views.

VARNISHES, VARNISHED SURFACES, AND THEIR PRESERVATION.

By Charles E. Copp.

Mr. President and Gentlemen of the Club, — We are told in the best book ever published — the one that has attained the widest circulation at any rate — not to covet our neighbor's house, nor his wife, nor his man-servant, nor his maid-servant, nor his ox, nor his ass, nor anything that is his; all of which, of course, we railroad men have been particular to observe up to date (?), but there is one point the writer will have to plead guilty to, he does covet the knowledge of chemistry which such men as Prof. Sabin and Dr. Dudley possess; for with them and their like is the key of knowledge in regard to painting materials which, to many of us, are more or less a mystery. With culture and training added, this is really a rare gift. And are we not taught in this same book, before referred to, to "covet earnestly the best gifts"? But the shining condition of the tops of some of our heads admonishes us that it is too late for us to retrieve our lost oppor-

tunities in this direction in order to shine in the realm of science and literature. Some of us began wrong to learn the painting business; we began at the top and have worked down, which is all right if you are digging a well. We began as letterers and stripers, the writer especially; then we went away and learned the theory of painting; and now the chemisty of painting confronts us as the deepest and hardest lesson of all, and no time left to learn it in. Our next lesson we may have to recite in one of the higher rooms above before another Teacher. Would it not have been better if we had begun the reverse of the way we did, and acquired some of the rudiments of the chemistry of painting, and then the practical theory, and lastly the ornamental part? Would it not be advisable for apprentices of the present day to think of these things? Nevertheless, in knocking about from pillar to post and from one thing to another in life's busy current we have found out some things by experience, and things learned this way are very valuable to us, if the tuition has been sometimes very dear.

Mr. President, I believe that the proper *use* of varnishes and the *care* of varnished surfaces on railway equipment are just as important as the materials themselves which chemistry has furnished us. I do not believe anything new remains to be discovered as a preservative coating for this work that will go beyond all present expectations of durability to the disregard of that care and oversight which we have been wont to exercise in the maintenance of the expensive finish of rolling stock. I can name on my fingers' ends as many reputable brands of varnishes that, if properly used and cared for and everything else being equal, "your heirs and assigns" would never know the difference in their wearing qualities. The writer went to the railway station the other day to examine a car on the train on which two well-known varnishes had been put in competition eleven months previously; and as he went round and round the car, squinting to observe which looked the best, his movements aroused the curiosity of a bystander or two who were intelligent men, and at his suggestion they too looked to find where one varnish began and the other left off, but they could not see any difference. In fact, the passengers inside were living in blissful ignorance of the stupendous event of this varnish test on the outside, and the car had not run off the iron the whole year on account of it. I do believe, and I am here to emphasize this fact, that regularity in the matter of varnishing railway equipment as to time especially, but as to methods and materials also, has more to do with the uniform appearance, good results, and preservation of your rolling stock than the matter of the choice of any one of the few reputable

brands of goods that are being pressed on your attention, no matter how good they may be, or how elevated an opinion we may have of them.

To illustrate: here is the matter of the longevity of man's life. No man has ever found the spring of perpetual youth, or the elixir of life from which he may quaff its vitalizing fluid and live on and on; yet we have some old and useful men among us, our venerable Mr. Adams, for one. And to what may we ascribe their vitality? In nine times out of ten it is to regularity in their habits of life, which have been also simple and plain. It was not what they ate or drank, or refused to eat or drink, so much as it was that they ate, drank, and slept regularly. Some are scared at pork, and others at tuberculosis. I know a man in Chicopee Falls, this State, who is well on toward ninety years of age, and still hale and hearty; and he says, "You ought to see the drove of hogs I have eaten." And another thing; if he had not been addicted to the use of tobacco he might have lived to a good old age! If he were to visit you he would insist on having his supper at five o'clock, and that of a very simple character.

It is much the same with a good watch as a timekeeper. We are told by the jeweller from whom we purchased it that it is best to have some regular time for winding it; and also, that it should be cleaned and oiled about once in so often to obtain the best results.

If this is so in these and many other departments, it is emphatically so in the matter of the preservation of varnish on a car. But how often are cars ruined when new, because their first run before revarnishing has been too long, under the mistaken notion indulged in by somebody that a new car, or a car newly painted and varnished, ought to stand longer than an old one which has simply been revarnished, when the reverse of this is the truth! And when once ruined in appearance, your new car is an unsightly old one all the remainder of its life, until painting time comes around again.

Am I stating it too strongly when I say that the practical painter who has produced these surfaces should have the care of them until they return to him again for further treatment? Should he not at least be accorded some under-inspection and control of them? Who should know better when a car needs revarnishing than he who painted and varnished it in the first place?

But I am not here to argue this point. You will at least agree that regularity in the matter of *time* of revarnishing, everything else being equal, has much to do with the durability of varnish. Well, it has no more to do with it than regularity in the matter of *material* used. "Oh, I thought you said a moment ago that it made little difference about this!" Not exactly. What I mean is this: Tom's varnish on the

car this time, Dick's next, and Harry's next, will ultimately "raise the old Nick" with any car.

In this connection I will offer a thought or two on testing varnishes. Just because two or more varnishes that are put on a car in competition run together for the first year with but a trifle difference in durability, it is no proof that the varnishes are nearly equal in permanence. In fact, if each varnish could be repeated from year to year on its own basis at each time of revarnishing for about seven years, there might be then a vast difference in favor of one varnish. To illustrate my thought, you mechanics who have divided a circle into a dozen segments know that a slight variation in the span of the compass at the start gets to be very large when you have spaced off the whole circle. It is much so with a trifling deficiency in the durability of a varnish which appears the first year; it may be startling at the end of seven years, if by use it is repeated so long. Now then, if you have a varnish you have proved the wearing qualities of by five years' use, you may well hesitate to change it for an uncertainty, unless you have good reason to believe it is deteriorating in value.

Then again, I find a great variation in the durability of varnish from the methods of different men in applying it. One man puts on double the amount of what another does; consequently his work stands the best, because the more is laid on evenly the better it will wear. This fact alone is enough to render void varnish tests where two men do a car, one using one varnish and the other another, and both meeting in the centre of each side of the car. If two men, picked for their equalities in this direction, do a car, perhaps a fair test enough for all practical purposes might be made.

Finally, I believe in the judicious cleaning of varnished surfaces while in service. Nothing can be much more detrimental to varnish than to allow the accumulated deposit from the locomotive stack, mixed with steam and oil from the cylinders, containing a large percentage of sulphide of hydrogen, to remain on the car from one year's end to another, to say nothing of its bad appearance. There are various detergents on the market for this purpose which I think it would be well for you to look into and experiment with. I need not name them, though I have in mind several such articles which are not only non-injurious to the varnish but preservative of it.

Thanking you for listening so long to what "I believe," I submit it to your respectful attention.

The President announced the following as a Nomination Committee to report the names of gentlemen as candidates for election to the

various offices of the Club at the next meeting: J. W. Marden, T. B. Purvis, Jr., F. D. Adams, F. E. Barnard, and Charles Richardson.

He then called upon Mr. McKenzie to address the meeting.

Mr. John McKenzie. I don't know why you call upon me to talk upon the subject of paints and varnishes. I have the honor to be one of those who employ men to put on paint and varnish to cars. We have heard the story of King Richard of England, who called upon the sun to make a mirror that he might see his image. I suppose they did not have any mirrors then, but if they had had the varnish we have to-day he would not have had to call upon the sun, for any one who walks past any of our coaches can see his reflection in it. I think the superintendents of motive power are rather too severe upon the paint and varnish men in this way; they ask them to turn out too many cars in the course of a year. They say that such or such a car needs attention, looks bad, and must be fixed up. The painter says the car is all right, that he is watching it; but that makes no difference, the superintendent wants it turned in, and wants it done in a hurry, and the painter is not allowed a proper time to repaint the car as it should be done, and it goes out too soon, and when it shows the effect of this hasty work it knocks the glory out of the painter.

Having been hard at work all day with the Arbitration Committee, I am very tired, and as you wish to hear from others who can treat the subject better than I can, I will not trespass further upon your attention.

Mr. J. W. Marden. I think this subject is quite an important one for even superintendents of motive power or master car builders. What I would like to hear to-night, in addition to the general treatment of the matter as presented in the last two papers, which are the only ones I have heard, as I did not get here early, is the experience of some of our master painters and shop foremen, and perhaps master car builders and superintendents of motive power, as to the method of cleaning and varnishing cars. We quite often have cars which, after they have run a short time, will begin to look badly, the varnish will lack gloss, and later will be all gone. This may be due to the way the varnish has been applied, the short time allowed between coats of varnish, or the time allowed between the application of the last coat and the running out of the car, or it may be due to the way the car is used after it leaves the shop. We know there is a large amount of money spent for varnishing cars; and it seems to me there may be a good chance to save money by giving each other our experience in this matter of handling varnished cars, and that is what I would like to hear something about from some men who have had practical experience.

Mr. W. E. Hibbard, of the Boston and Albany Railroad. My idea is that a good deal of the cracking of the varnish on cars is due to the fact that we are obliged to do the varnish work in too short a time. The New England roads especially do not allow a proper time for two coats.

I think if it were the practice to run the cars in once in eight months and give them one coat of varnish, the varnish would last longer and look better than it does now and clean easier. The car would not have to be retained so long in the shop, and would dry better. Now, it is frequently the case that a coat of varnish is put on a car and in two days another coat is applied before the first one is fully dry. One great disadvantage to the cars is that all kinds of mechanical work connected with them is done in the paint shop, except the blacksmithing. If the work is hurried, and the upper coat of varnish is put on before the lower one is fully dry, there will be pulling and hauling between them, and the result of this conflict will be seen in the bad appearance of the work; and I am convinced that a single coat applied once in eight months would give far better satisfaction both to the painter and the manufacturer.

Mr. Copp. I would like to say that I agree with Mr. Hibbard in what he has said. We had the practice, several years ago, of giving a car, when it was newly painted, two coats of varnish, and letting it run eight months, and then taking it in and doing it over. That was the theory, at least; but we found that eight months got to be nearer three times eight before we got the car again, and then it was in a bad plight. Consequently we adopted the plan of giving every new car three coats of varnish, allowing a few days to intervene between the first and second, and between the second and third coats, allowing sufficient time between coats for drying, and they will so amalgamate together that I do not think there is any special danger of cracking if that method is carefully carried out; and if cracking occurs I think it comes from other sources. I would like to hear something on this subject from Mr. Bailey, of the Concord and Montreal road, my esteemed predecessor on the Boston and Maine.

The President. I should be pleased to hear from Mr. Bailey also.

Mr. Bailey. I had rather talk about anything else in the world than about painting. I have been talking about it for forty-three years, and don't know much about it yet, and I learned some things about it at the last meeting. I learned that the proper way to paint a locomotive tank is first to apply a coat of boiled oil. I am glad I came and learned so much. I don't know any more about

painting than a Democrat knows about tariff. (*Laughter.*) Sometimes the results are different from what we anticipated. It is a matter that changes so much I have no settled rules, but I am governed entirely by the conditions existing at the time. If we should talk about painting all night, I don't think we should know any more about it; it is something we have got to learn in doing the work. I think if the painter had the full time required to do his work, and had his say about the stock and the help, and the cranks of the corporation would serve some of the selling agents as Napoleon did his commissaries, we should be all right.

The PRESIDENT. We should now like to hear from a Democrat on this subject, if there is one here. I will introduce to you Mr. Brown, ex-master painter of the Old Colony Railroad.

Mr. SAMUEL BROWN. I have been thinking ever since the last meeting that the man or men who formulated the subject we have been talking about and listening to really had something definite in his or their minds that they wanted expressed here. Mr. Marden has told us what he wanted practically, what he expected to get out of this meeting. Each and every one who has addressed the audience has dwelt largely on the amount of time allowed to do a piece of work, and on the quality and material, and I guess that it is pretty well established that the painter demands a reasonable amount of time for his business; he must have it, or he cannot give you the satisfaction that you require and ought to have.

The gentleman who read the paper upon varnish referred to the action of noxious gases and moisture upon a varnished surface where it is at all porous. There is one way in which that can be overcome, and that process has been discarded, I am sorry to say, and that is by rubbing. I am not strongly in favor of the repeating process; I am more in favor of Mr. Hibbard's plan, of putting on not so much varnish at a time, but doing it a little oftener. It has been my experience, a pretty practical experience, that shellac is a valuable thing in this line; and at my own home many of you will know that I was called "Shellac." I am a strong advocate of the use of shellac for many purposes, especially the interior of cars. I had a car on the road on which it had been freely used which was in service seven or eight years without renewing, and there are men here who examined that car when we went to Plymouth on our excursion, many of whom had had a pretty hard shot at me because I talked shellac so much; but when they examined that car, one of them, Hartshorn, said he would never say a word against shellac as long as he lived. I have a water-closet seat finished in shellac five years ago, and it is in good condi-

tion to-day, so much so as to need nothing done to it now. One of the men who examined the car above referred to asked me how I handled the shellac, and I explained to him that my method was to use corn-starch for a filler, then give the surface four coats of shellac, and rub it with linseed oil and pumice stone. I aimed at durability, and I got it. That car was only one of many that during the past ten or eleven years I was on the road I finished in that way in the interior, with shellac, then rubbing with oil and fine pumice stone. The one I refer to more particularly as having been in service for seven or eight years didn't cost the company half a dollar a year to maintain above the window stools.

Mr. Marden has asked some one to suggest a good practical method of taking care of cars while they are in service, and also preparing them for service. I think Mr. Hibbard has stated it. It never was my method to put on any more material as a varnish than would protect the paint or wood; just get enough on to protect it, and do it often enough to keep the surface right. If you let the car come in once in eight months it does not require such an amount of rubbing to clean it as it otherwise would, and you don't get the bad results that follow the application of a large amount of material upon it, and keeping it out longer, and it will give better satisfaction in every way.

At one time I took a car one side and used six different kinds of varnish on it. I did six panels with each varnish, and three of each I rubbed previous to putting on the second coat of varnish. If Mr. Gleason were here, he would tell you he could see the difference in the wear of these panels, between those that were rubbed and those that were not, the former resisting the action of the weather upon the varnish much better than the latter. While the railroad people require the cars to be got out of the shop speedily, may it not be advisable to go to the expense of rubbing while doing the work? Each individual must settle that for himseif, but that method will give you better results, and the car will last longer. I will venture to say that a car with only the proper amount of varnish to protect the surface, rubbed nicely, will give you three or four months' longer service than one where three or four coats are piled on, and it is run out before either of them is half dry. I think it is pretty well established that the nature of this material requires time in handling it, and the proper length of time for drying must be decided by each person, and by the conditions in each case. I might give you a formula for mixing paint, and the conditions of your shop might be such that a different time might be required there from what would be needed in my shop.

Mr. Bailey said he had learned something from the discussion of this

subject. We have been told something to-night in regard to lucol oil and its properties. Mr. Richardson told us at the last meeting that he believed a combination of zinc, lead, and silex is better than pure lead, that pure lead will not stand the action of the weather. My experience is that there are combinations that are better than straight goods. If we go to an apothecary's store with a prescription, we seldom get one straight article, but something from five or six different bottles; the combination cures the disease, one straight thing would not do it.

If we are taking the liquids which some gentlemen indulge in as beverages, some prefer them in combinations, and others take them straight. I don't know whether the Arbitration Committee got to that point to-day or not.

The PRESIDENT. We have with us Mr. Rhodes of the C. B. & Q., and we would like to hear from him.

Mr. G. W. RHODES. I hesitate a little about addressing you, on account of reflections being cast upon the Arbitration Committee. Perhaps if I do not speak entirely according to your views, you may think I am a little off. The subject of paint, which you have been discussing, is, I think, a very interesting one, and one to which the superintendents of motive power, master car builders, and master painters have had to give a great deal of attention of late. I think the matter of keeping up a car or engine in first-class condition is not so very difficult; I don't think it troubles the master car builders. I think the question is how to keep up their engines and cars in good condition with the limited means at their hands. Out in the West we have had for a number of years past, as you know, reduced earnings, and we are all studying to see how we can keep up our equipment with the least expenditure. I think the master car builders should consider the matter from that standpoint. I take it that if the management are willing to have an engine or car appear in a certain shape, or with a certain irregularity of color, that is one problem for the painters to consider. On our line the passenger equipment has cost us to maintain four mills per car per mile. I recollect some four years ago a prominent road found that its freight cars were costing them about eight mills per car per mile. The Pullman cars are run at about three cents per car per mile.

The question of appearance, starting with the engine, has never cut a great figure on our line; we never shop an engine for paint. Not long ago we were discussing the question of bridge painting. The paint that was usually used on bridges I believe cost sixty cents a gallon. A paint was offered, with which a bridge was painted, which cost one dollar a gallon, and only one coat was required. One day, in going

over the road with the management, we were speaking about the varnish-paint which was being used generally and pretty successfully on locomotives, and we mentioned that on our line we had abandoned the use of varnish on locomotives, and we used in lieu of varnish, paint. The general manager said, "Why wouldn't some of those varnish-paints be a good thing for our bridges?" This varnish-paint costs about $2.70 per gallon. The answer that was made was that it was too expensive. Then the question was asked, "Why wouldn't the bridge paint, which costs $1 per gallon, answer for the locomotives?" That is put in a very crude way; they didn't quite mean that, but meant that it was not possible at the present time to put very much labor and material on our locomotives in the way of painting. That was agitated through our shops, and it was asked why the bridges were painted. The reply was, to keep them from rusting, and when the bridges are repainted it is done on account of rust, and therefore it would seem to preserve their strength; and as the bridge is a very important structure, everything should be done to preserve it in good order. I said to one of our painters, "Now if it is essential that the bridge should not rust, and if we paint our locomotives for the purpose of preventing them from rusting and deteriorating, if the method we have adopted for painting locomotives is the best for accomplishing that end, why not paint the bridges in the same way, filling up, painting, and rubbing it down?" He said, "It is not necessary to do this work on a locomotive to prevent it from rusting; it is only done for the sake of appearance." I said, "I am sorry to say we are not in condition to do anything for the sake of appearance." As a matter of fact, we never shop our locomotives for appearance, only when the machinery gives out. We have taken up the line of trying to turn out our locomotives, so far as the paint is concerned, by only doing on them what is necessary to prevent the parts of which they are made from rusting and deteriorating, not for appearances. I know that is a very disagreeable order for any master painter to follow out, but I believe when he sees that the company he is working for is hard pushed, that these economies in all branches are practised, that he will turn in and accord with it as well as anybody else will.

I have followed that up in the same way in the coach line, and other roads do the same. In the present depressed condition of affairs they are not putting on the high finish nor the amount of labor on the equipment that the condition of the equipment in the East may warrant. The varnish on some lines is abandoned, temporarily abandoned, and varnish-paint has taken its place. By that what is saved is the labor, not so much in the material. What costs on the

coach is the labor you put on it. If you turn a coach out after subjecting it to seven or eight different operations, that means seven or eight different amounts of labor. Now, if by using some other method you can omit one half these operations, you save half your labor. I felt a little like criticising some varnish makers and paint makers, and telling them they are not keeping quite up to the demand of some of the railroad companies, or what some of their customers call for. If you go to a clothier or a hatter, you don't find that he insists on selling only high-priced goods; he will have his $100 suits, $80 suits, $60 suits, $40 suits, $20 suits, and $15 suits, and when his customers go to him he can supply them with what they can pay for. I have urged the varnish makers and painters to try to work towards this demand, which the present hard times is forcing upon some of the railroads, but I have met with but little success in doing it, not as much as I expected.

I believe that is about all I have to say on this matter. I want, while I am here, to say how much interest we take in the proceedings of your New England Club. I think the movement that has been made by the various clubs during the last couple of years has been very creditable to everybody connected with them. I don't believe there is any literature which is more useful and does more good than that which is the result of their proceedings, and the interchange between the different clubs is of great benefit; and no more welcome papers come to my desk than the records of the doings of the New England, New York, Central, and Southwestern Clubs. Their work during the last year indicates that it is not only the master mechanics and master car builders who take part in their proceedings, and it is not really essential that they should be present at the club meetings; the young mechanics are eligible, and they are made welcome at the clubs, and often they present papers which bring about very satisfactory results. Some of the roads in the West are carrying out this idea on their own lines, and they have regular meetings of master mechanics, superintendents, and foremen in charge, and in that way the views of the men in the different branches are collected together; and some papers have been presented by men who can do better in that way than in attempting to express themselves orally in a discussion, which is not always an easy thing to do; but at their leisure they can write out their thoughts, and afterwards read them, and these papers are often of much value in such meetings.

Mr. Brown. In regard to the care of cars in service, I am strongly in favor of wiping instead of washing; I think too much water poured on to a car is not good; it will get into the joints, and it is hard work to get it out. Wiping instead of washing is preferable at any time.

Mr. William Robinson. Mr. Rhodes referred to the painting of bridges to keep them from rusting. We all know that rails are kept bright by trains running over them, and do not rust. As that is the case, may it not be that bridges, owing to their constant vibration, caused by trains passing over them, will last well without painting, and not rust? Is it not true that locomotives are run without painting and without rusting? Possibly some gentleman may have had experience in that line, and can give us information in the matter.

The President. I have the pleasure of introducing to you Mr. John W. Cloud, secretary of the Master Car Builders' Association.

Mr. John W. Cloud. I don't remember that I have attended a New England Club meeting before and listened to its discussion. I do not feel that I can add anything to the subject immediately under consideration, paints and varnishes; but inasmuch as the chairman has mentioned me as the secretary of the Master Car Builders' Association, I should like to second Mr. Rhodes's previous mention of the esteem which the National Master Car Builders' Association entertains for the railroad clubs. I think the Executive Committee, the Arbitration Committee, and the officers generally and leading members of the Master Car Builders' Association, and perhaps all the members, realize that a National Association, meeting as it does once a year, cannot take into consideration these questions of detail, which it is necessary to have considered in meetings of these clubs before any standards can be reached. I do not refer only to your discussion of mechanical construction and such things. It is by the illustration and discussion of questions of detail in these smaller organizations that the members of the Master Car Builders' Association, when they meet yearly to handle the broader questions that properly come before them, are aided; they have got the points brought out by these discussions in their minds, and this conduces to a satisfactory general result. They look upon these railway clubs as bright stars in this firmament, and of great assistance towards the accomplishment of the ends which they seek. I only need add that the Association always looks eastward for the latest and perhaps safest information.

The President. I should like to say that some time ago I received a communication from the Southwestern Club containing the following resolve: —

"*Resolved*, That the secretary be instructed to communicate with the secretary of all the railway clubs, with request that they urge the executive committee of their clubs to appoint a Committee on Revision of Rules at once, with instructions to communicate to their secretaries not later than April 1, 1895, the result of their labor, and that the

secretaries be then requested or instructed to send the recommendations of each Revision Committee to each other club, for discussion at their following meeting. The object of this resolution is to bring about, if possible, recommendations before the Arbitration Committee that will be more uniform in purpose and expression from the different clubs than has heretofore been the case."

I wish to say now, in this connection, that within the next ten days I will call a meeting of the Executive Committee, with a view of bringing this matter before them, so that we can furnish this information before April 1.

I did not have the pleasure of hearing the paper on Lucol Oil, which was read this evening, and I have heard no discussion in regard to that. We have a few minutes to spare, and, if there is anything to be said on that subject, the time might be used for that purpose.

Mr. Brown. I understand that the Boston and Maine road have been using the material for two years; Mr. Cobb has also used it at South Lawrence, and I, for one, would be glad to know the views of those who have had experience with it. I had the pleasure of seeing a letter which Mr. Kern addressed to the lucol oil people, and he spoke very highly of it. I should like to know how it has worked in practical use.

Adjourned.

New England Railroad Club.

ANNUAL MEETING,

March 13, 1895.

List of Members.

Published by the Club.
EDWARD L. JANES, SECRETARY, P. O. BOX 1158,
BOSTON.
1895.

OFFICERS FOR 1895–96.

PRESIDENT,
L. M. BUTLER,
Master Mechanic, N. Y., N. H. & H. R. R.

VICE-PRESIDENT,
J. MEDWAY,
Supt. Motive Power, Fitchburg R. R.

SECRETARY,
EDWARD L. JANES,
B. & A. R. R.

TREASURER,
CHARLES RICHARDSON.

EXECUTIVE COMMITTEE,

JOHN T. CHAMBERLAIN,
Master Car Builder, B. & M. R. R.

F. D. ADAMS,
Master Car Builder, B. & A. R. R.

J. W. MARDEN,
Supt. Car Department, Fitchburg R. R.

F. M. TWOMBLY.

T. B. PURVES, JR.
Master Mechanic, B. & A. R. R.

C. E. FULLER,
Supt. Motive Power, Central Vt. R. R.

THOS. KEARSLEY,
Supt. Motive Power, N. Y. & N. E. R. R.

HENRY BARTLETT,
Supt. Motive Power, B. & M. R. R.

F. D. ADAMS, President	March,	1883,	to March,	1885.
J. W. MARDEN, President	"	1885,	"	1887.
JAMES N. LAUDER, President	"	1887,	"	1889.
GEO. RICHARDS, President	"	1889,	"	1891.
FRED. M. TWOMBLY, President	"	1891,	"	1893.
JOHN T. CHAMBERLAIN, President	"	1893,	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, March 13, 1895.

Vice-President L. M. Butler occupied the chair, and called the meeting to order at 8 P. M.

He stated that a letter had been received from the retiring President of the Club, which the Secretary would read.

The Secretary read the letter, as follows: —

Boston, Mass., March 9, 1895.

Officers and Members of the New England Railroad Club.

Gentlemen, — Owing to a pressing business engagement which I have in Chicago, which should have been met several days ago, but which I was prevented from keeping at that time on account of serious illness in my family, I shall be obliged to go to-day, and the result will probably be that I will not be at the last meeting of my term.

I desire, on this occasion, to thank the officers and members of the Club for the most hearty co-operation they have given me during my two terms as President. Without any hesitation, I can say that I look back upon the past two years as being one of the most successful periods in the history of the Club, and I fully realize that the credit

for the same is due to the hearty co-operation which has existed between the officers and members; and I see no reason why the future of this Club cannot be as successful as its past, and I bespeak for my successor the same hearty co-operation that has been given me during my term as President.

In closing, I wish to express my thanks to the members for the courtesy shown me as presiding officer of the Club, and I can assure you that any mistakes that have been made were of the mind and not of the heart, as I have never had any desire to hurt the feelings of any one.

Very respectfully yours,

J. T. CHAMBERLAIN,

President New England Railroad Club.

The Secretary and Treasurer then read the following reports: —

TREASURER'S REPORT, NEW ENGLAND RAILROAD CLUB, FROM MARCH 14, 1894, TO MARCH 13, 1895.

DR.

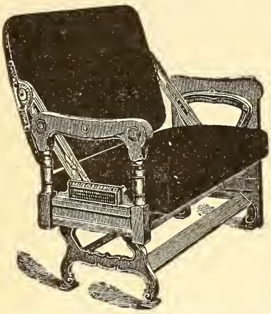
Balance on hand, March 14, 1894		$1,464.81
Received for advertising		3,125.00
Received dues for 1894–95 from 358 members		716.00
Received dues for 1895–96 from 2 members		4.00
Received back dues		8.00
Received for excursion tickets, etc.		138.50
		$5,456.31

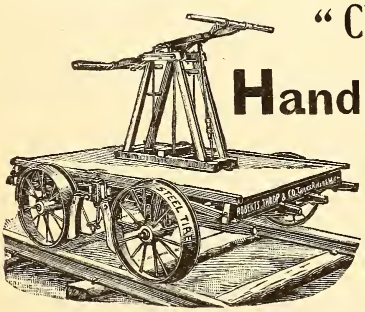
CR.

Bills paid as reported on cash book	$3,943.31	
Balance in bank, March 13, 1895	1,513.00	
		$5,456.31

Your Finance Committee beg leave to report that they have examined the accounts and vouchers of the Treasurer of the New England Railroad Club for the past year, and hereby certify that we find them correct.

A. G. BARBER.
GEORGE H. WIGHTMAN.
CHARLES RICHARDSON.
F. E. BARNARD.





To the New England Railroad Club.

Gentlemen, — Your Secretary respectfully submits the following report of the condition of the Club during the past year: —

The whole number of members at present is 367. Thirty-two new members are to be taken in to-night, which will make the total membership 399, as against 275 a year ago.

Seventeen members have not paid their dues for the past year. We should be glad to hear from them in the future, and trust they will pay and continue their membership.

The average attendance for the year has been 103, as against 57 for the previous year.

Six of our members have died: T. W. Getman, James N. Lauder, George Dunbar, John B. Cox, L. Packard, H. G. Thomas.

Our advertising friends have been more than kind to us, and we have collected a much larger amount from them than we did the year previous.

The reports now presented to you show that the efforts of our officers, in behalf of the Club, have been attended by very gratifying results, and they are to be congratulated upon their success, and there is no reason to doubt that in the months to come the Club will keep up to the standard which it has attained in the past.

On motion of Mr. Fuller, seconded by Mr. Twombly, it was voted that the reports of the Secretary and Treasurer be accepted.

The committee appointed at the last meeting to nominate officers for the ensuing year reported the following list of names, and as the result of the balloting these persons were declared elected: —

President, L. M. Butler, M. M., N. Y., N. H. & H. R. R.; Vice-President, J. Medway, S. M. P., Fitchburg R. R.; Executive Committee, John T. Chamberlain, M. C. B., B. & M. R. R., F. D. Adams, M. C. B., B. & A. R. R., J. W. Marden, S. C. D., Fitchburg R. R., F. M. Twombly, M. M., N. Y., N. H. & H. R. R. (Providence Division), T. B. Purves, Jr., M. M., B. & A. R. R., C. E. Fuller, S. M. P., Central Vt. R. R., Thos. Kearsley, S. M. P., N. Y. & N. E. R. R., Henry Bartlett, S. M. P., B. & M. R. R.; Treasurer, Charles Richardson; Secretary, Edward L. Janes, B. & A. R. R.

The Nominating Committee recommended that the Finance Committee be reduced to three, but made no nominations for that committee, holding the matter over until the next meeting.

They also recommended the appointment of an Auditing Committee.

It was voted that the report of the committee be accepted.

Mr. Medway gave notice of a motion to come up for action at the next meeting, as provided in the By-Laws, to amend the Constitution in accordance with the recommendation of the Nominating Committee, so that Section 5 shall provide for a Finance Committee of three members instead of nine, the President of the Club to act as a member *ex officio*.

On motion of Mr. Medway, it was voted that an Auditing Committee of three members be appointed, and that the Nominating Committee be continued until the next meeting, and present the names of three persons as nominees for such Auditing Committee.

Mr. Graham gave notice that at the next meeting he should move to have the nominations for officers of the Club presented one month before the annual election.

Mr. Gray was then introduced by the President, and gave an exhibition of the phonograph, which rendered a pleasing variety of songs and speeches for the entertainment of the audience, after which a vote of thanks was extended to Mr. Gray for the performance.

The President announced, as the subject for discussion at the April meeting, "The Revision of Interchange Rules for Freight Cars."

Mr. Marden suggested that the Club should have a picture of the late James N. Lauder, and moved that a committee of three be appointed to take the matter into consideration and report at the next meeting. The motion was carried, and the President appointed as such committee, Messrs. Marden, Medway, and Twombly.

Adjourned.

LIST OF MEMBERS.

Adams, F. D., M. C. B., B. & A. R. R., Allston, Mass.

Allen, Prof. C. F., Massachusetts Institute Technology, Boston, Mass.

Armstrong, George W., B. & A. R. R., Boston, Mass.

Averill, A. B., 108 Austin Street, Cambridgeport, Mass.

Adams, T. W., Allston, Mass.

Akers, George J., Astor House, New York City.

Adams, George F., General Foreman, B. & M. R. R. Car Shops, Nashua, N. H.

Arey, S. R., General Foreman, B. & M. R. R. Car Shops, Salem, Mass.

Adams, Guy A., Joint Inspector, F. and B. & M. R. R. Companies, Ayer, Mass.

Aiken, C. L., M. M., B. & M. R. R., Worcester, Mass.

Ashton, Albert C., care of Ashton Valve Company, 271 Franklin Street, Boston, Mass.

Atkins, Harold B., 255 South Street, Boston, Mass.

Appleyard, William P., General Foreman, Car Department, N. Y., N. H. & H. R. R., Kneeland Street, Boston, Mass.

Ager, George B., B. & A. R. R., Boston, Mass.

Baker, Charles F., M. M., West End Street Railway, Albany Street, Boston, Mass.

Benners, Edwin H., care of E. H. Benners Manufactuing Company, Elizabeth, N. J.

Bishop, R. R., Jr., care of L. C. Chase & Co., 129 Washington Street, Boston, Mass.

Blanchard, W. A., American Steel Casting Company, Chicago, Ill.

Bolton, Gilman B., 23 Court Street, Boston, Mass.

Brainerd, J. A., 125 Milk Street, Boston, Mass.

Burget, G., care of Ramapo W. & F. Company, Ramapo, N. Y.

Burns, W. B., Burns Automatic Coupler, Syracuse, N. Y.

Bushnell, E. M., care of Bushnell Manufacturing Company, Easton, Pa.

Bradley, Osgood, Worcester, Mass.

Barber, A. G., cor. Pearl and Purchase Streets, Boston, Mass.

Billings, G. H., 393 Dorchester Avenue, South Boston, Mass.

Brownell, F. G., Muncie, Ind.

Brady, D. M., 115 Broadway, New York City.

Barrett, A. R., Boston, Mass.

Baker, W. C., 143 Liberty Street, New York City.

Butler, L. M., Providence, R. I.

Bickford, N. B., N. Y., N. H. & H. R. R., Kneeland Street, Boston, Mass.

Brown, J. D., Bridgeport, Conn.

Brady, J. B., 908 Havemeyer Building, New York City.

Boutwell, Roland H., P. O. Box E E, Lowell, Mass.

Buchannan, E. G., 709 Havemeyer Building, New York City.

Barnard, F. E., 11 Oliver Street, Boston, Mass.

Braine, L. F., Ridgewood, N. J.

Bunker, George C., Foreman Machinist, N. Y., N. H. & H. R. R., Roxbury, Mass.

Barry, Robert, 115 Broadway, New York City.

Barbey, F. A., 152 Federal Street, Boston, Mass.

Burrall, P. S., care of Barnum, Richardson Company, Lime Rock, Conn.

Bowker, A. L., Crosby Steam Gage and Valve Company, 93 Oliver Street, Boston, Mass.

Bates, Edw. C., care of Crosby Steam Gage and Valve Company, 93 Oliver Street, Boston, Mass.

Bearse, Horace L., 401 Albany Street, Boston, Mass.

Berg, Walter G., Civil Engineer, L. V. R. R., 356 West 20th Street, New York City.

Baker, E. W., Purchasing Agent, Mexican Central Railway, 70 Kilby Street, Boston, Mass.

Barnes, David L., 1750 Monadnock Bldg., Chicago, Ill.

Bartlett, H., S. M. P., B. & M. R. R., Boston, Mass.

Bartlett, A. V., Union Station, B. & M. R. R.

Bursley, W. H., 109 Milk Street, Boston, Mass.

Burnett, C. C., Providence, R. I.

Clucas, Henry, Travelers Insurance Company, State and Kilby Streets, Boston, Mass.

Casey, Fred A., care of Ashton Valve Company, 271 Franklin Street, Boston, Mass.

Chamberlin, Eugene, 757 Prospect Avenue, Buffalo, N. Y.

Carter, F. H , care of A. & E. Burton, 21 Exchange Street, Boston, Mass.

Collis, Lloyd, Standard Coupler Company, 1055 Fifth Avenue, New York City.

Coghlan, John, B , R. B. & L. R. R., Boston, Mass.

Carey, George H., 1 Broadway, New York City.

Curtis, Francis M., Boston, Mass., P. O. Box 1576.

Creamer, W. G., 19 Platt Street, New York City.

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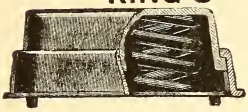

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Waldo, Dr. Leonard, care of Waldo Foundry, Bridgeport, Ct.

Walling, P., Superintendent Bridge and Buildings, B. & M. R. R., 10 Monahan Street, Lowell, Mass.

Weymouth, G. W., Simonds Rolling Machine Company, Fitchburg, Mass.

Woods, John M., 31 Lancaster Street, Boston, Mass.

Winans, W. G., Treasurer, Peerless Rubber Mfg. Company, 16 Warren Street, New York.

Whall, Frank R., care of Laminar Fibre Company, 180 Summer Street, Boston, Mass.

Young, John V., 620 Atlantic Avenue, Boston, Mass.

Zehnder, William D., care of Pennsylvania Bolt and Nut Company, Lebanon, Pa.

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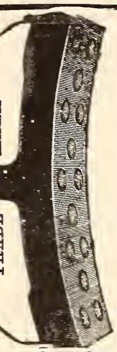

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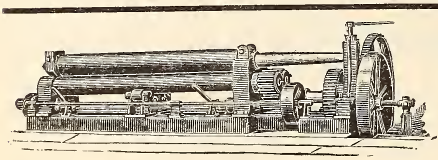

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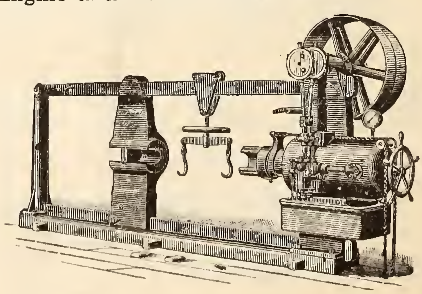

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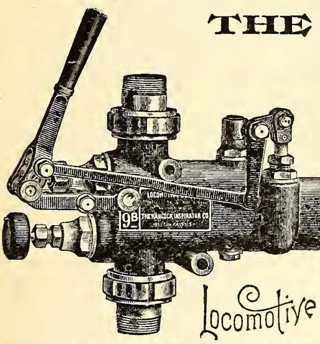

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PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, April 10, 1895.

President L. M. Butler occupied the chair and called the meeting to order shortly before eight o'clock, and said: —

The Nominating Committee, which was previously appointed, was by action at our last meeting to continue to this meeting. The Finance Committee was not elected, and action in regard to that matter remains yet to be taken. Is that committee ready to report further? It was proposed to continue the Nominating Committee, and it was proposed to reduce the number of members of the Finance Committee from nine to three, and that an Auditing Committee be appointed. I do not see that we can, under these By-Laws, change the number of the Finance Committee very well without changing the By-Laws. Regular notice has not been given as required, so I do not see that we can change them. As I understand, there has been no Auditing Committee appointed. That is something new. I am ready to hear any suggestion or anything that is to be said on this point. The Nominating Committee perhaps have formulated some ideas which they wish to present. If they have, there is an opportunity.

Mr. J. W. Marden. Mr. President, your Nominating Committee ask to have the matter of the Finance Committee laid over for the purpose of reducing it to three. They were under the impression that a written notification should have been given to the Club at our last meeting to have the By-Laws revised at our present meeting. With that understanding, they have made no provision to have a Finance Committee exceeding three. I have no further authority in the matter until the committee are again called together.

Mr. J. Medway. Mr. President, can we not amend our Constitution?

The President. I think we cannot amend the By-Laws without giving thirty days' notice in writing. That should have been done at our last meeting. A verbal notice does not answer the purpose.

Mr. Medway. May we not do that here constitutionally?

The President. I think not.

Mr. Medway. Then, Mr. President, I would give that notice in writing now for our next meeting.

Mr. F. D. Adams. Mr. President, I understood a suggestion was entertained or there was talk that the whole Constitution should be revised, and that a committee should be appointed specially for that purpose, as our Club has grown now to be quite extensive in its membership. When the Constitution was written the Club was very small. It would seem as though that would be a very advisable course, and if that was to be done, it would seem as though this move, perhaps, would not be advisable; that we had better do all under one head, and let this committee that is appointed to revise the Constitution make such changes, or present what they think advisable at the next meeting, which would accomplish the whole thing as well as Mr. Medway's suggestion of a change in one particular article of the Constitution. If I understand it, the idea of the parties suggesting this plan seems to be a good one, that the Constitution and By-Laws of the Club be revised. I do not know as I am prepared to make a motion to that effect, but if there are others who have some ideas in relation to it, I would like to hear from them.

Mr. F. M. Curtis. Mr. President, there is no article in the Constitution and By-Laws that looks to the appointing of a Nominating Committee. I think the entire thing is out of the question, and that the committee that Mr. Adams speaks of is entirely proper. There is nothing in the Constitution and By-Laws that says a Nominating Committee shall be appointed, consequently the appointment of any Nominating Committee for any officers of the Club for another meeting is entirely illegal.

The President. I would inquire if that has not been customary?

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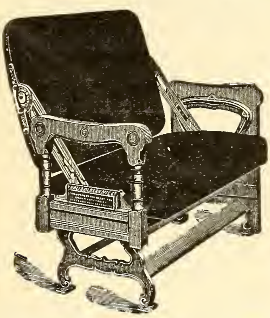

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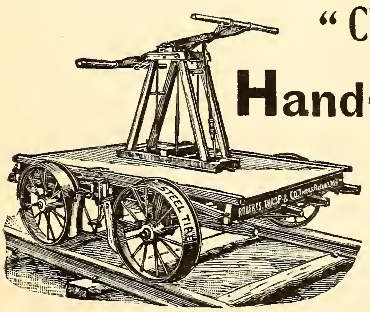

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Mr. Curtis. It has been, Mr. President, but it does not make any difference about the custom. The By-Laws are such that no custom can void what the By-Laws say.

Mr. Adams. I would like to hear, Mr. President, what the Constitution says in relation to officers. I do not think, whether it has been done by a committee or otherwise, it would make any difference as to the constitutionality of the election of the officers, whether they are brought before the Club by a committee or nominated in open club.

Mr. Curtis. The Constitution plainly says —

Mr. Adams. Wait a moment, Mr. Curtis, until I get through. I believe I have the floor.

The President. Mr. Adams has the floor.

Mr. Adams. I do not see how that would affect the constitutionality of the election of officers at all one way or another. If the Club sees fit to elect their officers or bring a list of officers before the Club through a nominating committee, they would have a perfect right to, whether the Constitution said so or not. It strikes me so.

Mr. Curtis. The Constitution says plainly they shall be nominated from the floor. I do not know whether it is good for anything or not, but under the circumstances it seems to me the Constitution should be conformed to.

Mr. Adams. Does it say that? I would like to hear that part of it read. I do not know what it does say.

The President. I will find it and read it: "The officers of the New England Railroad Club shall be elected by a majority ballot at the annual meeting, and shall hold their respective offices for the term of one year, or until their successors are chosen. Any vacancy occurring may be filled at any regular meeting of the Club."

Mr. Adams. Mr. President, that does not say they shall not be nominated by a nominating committee. It does not interfere at all with this plan. I infer from Mr. Curtis's remarks that he rather objects to the election of the present officers. Perhaps I am wrong, but so far as the constitutionality or legality of the election of these officers is concerned, they are legally elected according to the Constitution, if I understand it.

Mr. Curtis. The gentleman is in fault as far as the officers of the Club are concerned. I do not object to the officers elected, and will do the best I can to assist the Club in any way, shape, or manner, but the appointment of a nominating committee has simply been a custom, nothing else.

Mr. Adams. It is a custom universally adopted by all bodies.

Mr. Curtis. It does not make any difference about custom, as far

as the Constitution and By-Laws go. The Constitution does not provide for a nominating committee that shall present candidates for office for the ensuing year.

The PRESIDENT. I would say that while I do not remember seeing anything in the Constitution and By-Laws that there shall be a nominating committee appointed, neither do I find anything against the Club having the right, if it chooses, of appointing a nominating committee to present names here to be balloted upon. While that is so, I do not understand that any member here is under any obligation to ballot for a single name presented by that committee. He is at perfect liberty to ballot for whom he chooses. I think the election of officers was something that cannot be excepted to very well. The Club certainly has a right to appoint any committee it chooses.

Mr. CURTIS. I do not want it understood, Mr. President, that I have any objection to any officer, and I will give him my hearty support in any way I can. It was a practice begun years ago, and I simply claim that a nominating committee had no right to bring in the names as they did, and it is not in accordance with the By-Laws.

The PRESIDENT. Well, the Chair is ready to entertain any motion for the settlement of this business about the Finance Committee, in relation to what action shall be taken.

Mr. JAMES SMITH. Mr. President, in the absence of a clause of that kind this Club, the same as all other clubs and conventions of every name and nature, has but one thing to do, and that is to fall back upon the common usages of parliamentary law governing bodies. Now, sir, there is scarcely a convention of any kind held in Boston where there are offices to be filled but what they appoint a nominating committee, whether they have by-laws or whether they have not. That is the custom of the country in which we live; and while I respect what Mr. Curtis has stated, and I do not doubt that he is perfectly honest in his conclusion, I have no reason to think otherwise, still I beg leave, sir, to differ with him. I believe that this Club has the right, in the absence of a by-law in respect to that matter, to appoint a committee to nominate a list of officers, and have that committee make their report at the monthly meeting of this Club of the list of names they have selected, and then, as the presiding officer has well stated, each member has the right to vote for all of that list as presented, or select a new list, as each chooses. That is proper. I think that we have a perfect right to appoint a committee, and the precedent has been established for years in this Club. I think it is perfectly in accordance with parliamentary law and usage in this Commonwealth and in every other Commonwealth throughout the United States of America. (*Applause.*)

Mr. Marden. Mr. President, I think Mr. Smith is right; in fact, I know he is right. I had quite a little experience some years ago in parliamentary law. Your Nominating Committee was nominated by some members of the Club and voted for by the Club, and, with the exception of myself perhaps, it was composed of some of your best members. That committee assembled and carefully studied the situation, and without any prejudice whatever submitted to you a list of names for either your approval or disapproval. Now, there has been quite a little said adversely to what your committee has done, and we want it distinctly understood that there was no personal feeling in our minds in any way whatever in regard to the members of the Club that were presented for your approval. As for myself, and I think I speak for all the other members, I know that I had no personal feeling. We were working for the Club in the best way we could, and, as your President has said, every member of the Club had a perfect right to vote for or against any name that we presented. Now, as far as continuing the Nominating Committee is concerned, for myself I would very much rather withdraw from it, but it is perfectly legal for you to continue that committee if you wish to do so.

Mr. Adams. It seems to me that if the Constitution is ever going to be amended, now is the time to do it; and if it is in order, I would move you, Mr. President, that a committee of three or five, as may be thought best, be appointed to revise the Constitution and By-Laws.

Mr. Curtis. Mr. President, I second the motion, and in seconding it I would say that it is not a personal matter with me that I say what I do in regard to the Nominating Committee. I simply say the By-Laws of this Club are almost useless. It is certainly a desirable thing, as Mr. Adams has said, to revise the Constitution and have it in such a form that nobody can make an exception. I did not make my suggestion because of any objection to the officers elected, or because I was defeated at the last meeting. I simply say that I think matters of this kind have been conducted in rather a loose way, and I wish they might hereafter be conducted in a manner no one can question.

The President. There is a motion before the house that a committee of three or five be appointed by the Club to take up the matter of the revision of the Constitution and By-Laws governing this Club. The By-Laws as they are at present were adopted when there were but fifty or seventy-five members in the Club. It is now larger, and more things are at stake, and they need modernizing the same as other things do, and this matter is now before the Club for action at some future meeting. What would be your idea, Mr. Adams, as to when that committee should report?

Mr. Adams. At the next meeting, if possible.

Mr. F. M. Twombly. Mr. President, I would like to inquire if the Executive Committee has a recommendation to make to the Club on this subject.

The President. There were some minutes made of that. I cannot tell exactly what they were. The Executive Committee was in session last month.

Mr. Twombly. My object in bringing that up was to see how far they varied from Mr. Adams's motion.

The President. The Secretary will read the minutes.

The Secretary. "The Executive Committee recommend that a committee of three be appointed at the next meeting to revise the Constitution and By-Laws, and report at the October meeting." That was the recommendation of the Executive Committee.

Mr. Adams. It gives them more time, that is all.

The President. That would be the same thing as Mr. Adams's motion, only giving more time.

Mr. Adams. I have no objection to that.

Mr. Twombly. I see no objection to their reporting at the next meeting, if they can do so. The committee can get it done in a month, can't they?

The President. Are you ready for the question? It is moved and seconded that a committee of three be appointed to revise the Constitution and By-Laws of this Club, and, if they can, report at the next meeting. (The motion was carried.) How shall that committee be appointed?

Mr. James Smith. By the Chair.

The President. Of course, I have no objection to doing anything that the Club desires in that line, but I should be quite as well pleased myself to have it done by nomination.

Mr. Adams. Mr. President, in regard to the nominating of this committee, it of course requires a little thought on the part of the President.

The President. Certainly.

Mr. Adams. If the nomination was made in open meeting it might be done thoughtlessly and hastily; perhaps we should not get the best men for the purpose. This is quite an important matter, and it seems to me that if the President was to appoint them, he should take time to think it over for several days, and let the Secretary notify such men as the President may select for that committee. It strikes me that would be the safest way. Of course it is a matter of importance that we get members who are well qualified for that duty. I want it understood

that I am not going to be on that committee, because I do not feel that I am qualified to do that kind of business. I would like to have the President select some good, capable men that can present a Constitution and By-Laws such as we can work under satisfactorily and harmoniously, and will be for the interest of the Club. If it would please the meeting to give the President time to think it over and select such men, and then they be notified by the Secretary, it seems to me that would cover the ground.

The President. I would say that certainly I should not feel justified in trying to appoint that committee here this evening. I should want a little time to do it. That was the reason I rather wanted to put the responsibility on the Club of nominating their committee, but, however, whichever way the Club wishes it done will be satisfactory to me.

Mr. Adams. If it is necessary, Mr. President, I would move that the President appoint a committee, and have one week's time to make the selection, and that they be notified through the Secretary.

(The motion was seconded and carried.)

Mr. Twombly. Mr. President, I would like to ask Mr. Adams if that committee is appointed to revise the By-Laws and bring in their recommendations at the next meeting, if he thinks their report can be acted on at the next meeting, or will it have to go over to next fall, assuming we adjourn over the summer months?

The President. I will say I do not think this matter ought to be pushed very hard. Most of us have something to do all the time, and it would seem to me that this matter is one that should not be hurried; we can continue as we are pretty well, if the committee should not report until October. It looks to me, if I take a week in appointing this committee, that they will have only about three weeks to do their business in, and it would give them a rather short time in order to get these By-Laws into intelligible shape for our next meeting.

Mr. James Smith. Mr. President, I would like to inquire if you have a copy of the Constitution and By-Laws in the hall.

The President. There is a typewritten copy here.

Mr. Smith. Then I would further inquire if the present Constitution and By-Laws do not provide some way for their revision.

Mr. Adams. The Constitution does so provide, and I was going to say when Mr. Smith rose that with our present Constitution we cannot act upon it at our next meeting.

The President. That is it.

Mr. Adams. We could not do it constitutionally. The matter would have to lay over another meeting. In view of that we may need the Finance Committee in the mean time, consequently I would move that

there be a Finance Committee appointed for the present and until the Constitution is revised, with the number that is mentioned in the Constitution, a Finance Committee of nine.

The PRESIDENT. These are elected, as I understand, by ballot?

Mr. ADAMS. According to the Constitution, I think so.

Mr. JAMES SMITH. Mr. President, I do not want to interrupt the regular proceedings of the meeting, but I ask if the Constitution and By-Laws could not be read. If they are present I would like to have the article relating to this matter read.

(The Secretary read the article called for.)

Mr. SMITH. That is just what I wanted, and therefore, Mr. President, I do not see any objection to having a committee appointed at our next regular meeting.

Mr. MEDWAY. In view of the appointment of this committee for the revision of the Constitution and By-Laws, I would like to withdraw my motion in that regard, if I may be permitted to do so.

The PRESIDENT. What was your motion?

Mr. MEDWAY. That the Finance Committee be reduced from nine to three; the appointment of an Auditing Committee of three members, which I have just handed in in writing. I prefer to place the whole matter in the hands of the new committee.

The PRESIDENT. It would seem that in regard to any of these things it would not be exactly consistent to put in an amendment in writing in view of our having a committee to revise the Constitution and By-Laws, so I should suppose it would probably be best to withdraw that. Then it would be in order to proceed to the election of a Finance Committee. Is it necessary to have any motion for it?

Mr. ADAMS. I made a motion, but nobody seconded it.

Mr. MEDWAY. The motion was made at our last meeting; it was held over.

Mr. ADAMS. If I understand the Constitution, Mr. President, the Finance Committee holds over until another committee is elected properly. I would like to have the Secretary look at that and see if the officers do not hold their position until another set of officers is elected and qualified in their place.

The SECRETARY. That is right.

Mr. ADAMS. If that is so, the Finance Committee that is now serving is good for another year or until another committee is elected.

The PRESIDENT. I should think it would be well to let that remain as it is, and postpone the election of the Finance Committee.

Mr. ADAMS. I should think so. If there was no President elected, the old President would hold over, and so with all other officers.

The PRESIDENT. Is there any other business to come before the Club? I believe there is a letter which the Secretary has, and he might read it for the information of the Club.

The Secretary then read the following letter: —

BOSTON, March 13, 1895.

MR. L. M. BUTLER, PRESIDENT NEW ENGLAND RAILROAD CLUB, PROVIDENCE, R. I.

My dear Sir, — I wish to notify you that at the next meeting of the New England Railroad Club, I shall move an amendment under Article VI., that the list of officers to be elected at the next annual meeting shall be posted one month before the meeting.

Yours respectfully,

J. H. GRAHAM.

The PRESIDENT. I will say that letter was dated the 13th of March and received by me some two weeks or more later, but as it has not been presented before this meeting, it will stand as having been read here to-night and filed away.

Has any other member any business to bring before the Club? I believe there was a committee appointed to consider the matter of securing a picture of our late member, Mr. Lauder. Is that committee ready to report?

Mr. MARDEN. Mr. President, the committee is ready to report, and I will call upon Mr. Twombly to make the report.

Mr. TWOMBLY. Mr. President, your committee have learned that a nice life-size crayon portrait of Mr. Lauder can be obtained for twenty-five dollars, precisely the same as was secured by the employees of the New Haven Railroad under Mr. Lauder to send to Mrs. Lauder, and your committee would recommend that such a portrait with a frame be procured by the appointment of a committee, at an expense not to exceed thirty-five dollars. I presume there are a great many in the hall who saw that picture on exhibition in Mr. Lauder's office, and those who did will know about what such a picture would be.

The PRESIDENT. You hear the report of the committee on procuring a picture of Mr. Lauder; what will you do with it?

Mr. SMITH. I move, Mr. President, the report be accepted and adopted, and that the same committee be continued to procure the portrait.

(The motion was seconded and report adopted.)

The PRESIDENT. If there is no further business, we will proceed to the subject that is before the Club, which is "The Revision of Rules of Interchange for Freight Cars." I would say that this subject was discussed more or less at our December meeting. I was not present, but

I learned from the report that there was no decisive action taken about it, and it was the desire of the master car builders that there should be something done by the different clubs to get their sense of what they wanted placed before the Arbitration Committee by the 1st of April. It was laid over and no further action taken, until now it comes before this meeting, and it has been brought up here to-night. I have corresponded with Mr. Adams, Mr. Marden, and Mr. Chamberlain, requesting them to take hold of that matter and see what they could do to get something that would be satisfactory to the Club and that would be of some assistance to the Arbitration Committee. Mr. Adams and Mr. Marden are here, and, gentlemen, the matter is in your hands.

Mr. Adams. Mr. President, I acknowledge I received your letter making such a request, and I gave some attention to it. I will confess that I have not given much. One reason that I did not attend to it personally and enlist the other members who were mentioned as associated with me on this question was this: The Master Car Builders' Association, if I understand rightly, have appointed a committee to revise the rules of interchange. That committee simply asks the various clubs of the country to express their views and wishes in regard to the matter. I suppose it is voluntary on the part of the clubs to do so or not, as they please. This Club at the December meeting voted distinctly and quite unanimously in favor of the idea that each road should pay for the expense of repairing its own cars in the main. That idea has gone out, whether directly or indirectly. It has undoubtedly reached the ears and minds of this committee that was appointed by the Master Car Builders' Association. And they will undoubtedly give it some attention in making their report to the Association of what they would advise as to rules for the years to come. It was in view of this fact that I did not feel as though it was necessary for me to spend a great deal more time in looking the thing over. I have not even communicated with the other parties mentioned. I do not know what their views are in the matter. Mr. Marden is here, and if he has any different views, he can express them. Mr. Chamberlain is not here, and so he won't be able to say what he thinks about it, but those are the reasons and views that I had in the matter. I felt that the committee appointed by the Association was well qualified to bring forward an outline at least of rules of interchange such as were needed in view of the changes desired and the changes of views among the railroad people generally that have occurred in the last year. This subject has been agitated by all the clubs and discussed thoroughly in various places, and new regulations and rules have been introduced

and experimented upon, and they will be prepared to assist this committee very much indeed. I think some of the committee were parties to these changes too, and I have no doubt that when the Association meets there will be a schedule of rules presented there that will cover the ground sufficiently, and perhaps still better than anything that we could suggest, so that with that view of the matter I did not feel as though it was very important to spend a great deal of time about it. Whatever action you might take would be only advisory to this committee. They will produce whatever they may in their judgment see fit after hearing from the various clubs that have already reported to them undoubtedly, because I know some of the clubs that acted upon this question, and when their report is made, then the Association will take it up rule after rule, and act upon them separately and adopt such as they may think best and reject others. That is about the way in which I look at it. Mr. Marden may have some different views about it.

Mr. Marden. Mr. President and members of the Club, Mr. Chamberlain and myself made an effort to meet with Mr. Adams, but we have been unfortunate all the way through, both with ourselves and with him. I think that Mr. Adams had to go West to some point, then Mr. Chamberlain had to go to Buffalo, and I had to be away, and so we have not been able to get together. I approve of what Mr. Adams says in the matter. I do not know what we could do unless we were to take the rules rule by rule and express our opinion on them, and I do not know but that would be a waste of time. I think it would, perhaps. The matter is being agitated all over the country, and this committee that Mr. Adams speaks of has sent circulars to individual members, and expects replies from individual members to certain questions that have been propounded to them. The chairman of that committee is a wide-awake, energetic man, and I have no doubt that, as Mr. Adams says, something will be presented to the convention through the Arbitration Committee. I understand, however, this committee is to report directly to the Arbitration Committee.

Mr. Adams. I so understand it.

Mr. Marden. I can only say, perhaps what I have said before, that I believe thoroughly in the revision of the rules, and that in looking at it we should not look as car builders or heads of the mechanical departments simply to the expense that might be perhaps entailed in our own departments on account of any change that may be made in the rules, but we should look at the expense and the money that might be saved to the railroad company as a whole, taking

into consideration the hauling of freight, the delay of freight at inspecting stations, and in fact every point that can be got at, whether it may directly interest the car department or not. If we lose ten or fifteen cents, or if we add an expense of ten or fifteen cents for the repairing of a car, the passenger traffic can gain twenty-four or forty-eight hours in the movement of that car. They have undoubtedly made a great deal more money than we have expended, and whether we get the credit for it or not, it certainly goes into the treasury of the road. That is the way I am inclined to look at it, not particularly as concerning my own department, but as concerning the road as a whole, and I believe that the move that is being made is a move in the right direction, and will save money to the roads if it is carried out.

The PRESIDENT. I would say that this matter came before the December meeting. I was not present at that meeting, and all I know about it I got through the report of what was done; but at our last meeting there seemed to be something left out, that was not finished, — that was the impression I got, — and it was decided to take that matter up and give everybody a chance who had anything to say to say something in relation to it, and the time being rather short, I did not see my way out any better than to call upon my friends, Mr. Adams, Mr. Marden, and Mr. Chamberlain, as being parties who would know more about that, or as much about that as anybody, and if there was anything necessary to take action upon, it could be done here to-night. That seemed to be about all we had before the Club to talk about. If there is anybody else who has anything to say on that subject, there is now an opportunity.

Mr. ADAMS. There must be more people here who are interested in the car department, and know something about the rules of interchange, and I think they might have something to say. Some of our inspectors here are well posted on the interchange of cars, etc., and they might give us some light if they would say something. I wish there was somebody to talk a little, Mr. President, besides Mr. Marden and myself.

The PRESIDENT. It would be a very fortunate thing for this Club.

Mr. ADAMS. There might be a good deal said. Mr. Marden touched upon an idea in connection with the freight department or the transportation department in connection with those rules of interchange. Other parties are perhaps quite as much interested, I was going to say, as the car department itself. Perhaps the responsibility would not fall on them for broken cars quite so heavily as it would on the car department, if anything happened in consequence of cars being improperly inspected or interchanged; but it certainly is a fact

that the car builders of the country when these rules were formulated had in mind almost entirely, perhaps altogether, their own protection. All the rules have been revised from time to time with that idea uppermost, of our own protection, looking out that we did not get beaten by the other fellow. That is the main idea that has prevailed in the minds of all who have had to do with revising and fixing up these rules. Now that idea is considerably exploded. The most of our leading men who have charge of the mechanical departments are dropping that notion. They see a little bigger thing in it, that it is not so much that we should protect ourselves from being beaten by the other fellow as it is that we should move the cars as rapidly as we can safely; in other words, that we should stop inspecting for protection and inspect for safety. If a car is safe to run, let it run, and when it needs repair, then stop it and repair it. Let it go just as far as it will, and in ninety-nine cases out of a hundred it will go to its destination. If the car is a little doubtful, if it is defective in some way, something has damaged it; whoever has damaged it ought to pay for it. We tried to obviate that difficulty by putting cards on it and make the parties responsible who damaged it. That has helped to some degree, but it did not accomplish the end, because the next fellow would stop it and repair it, and send the card in with the bill as a voucher, and that gets him his pay. He might, if he was a little dull in business, stop the car on purpose to keep his men at work. He would have a right to do that under the rules. Now, that is not right, it is not fair. The main idea should be to push that car to its destination just as rapidly as it will go safely, and the only way to do that that I can see (and it seems to be the view of the men generally through the country, as I understand it) is to have each road responsible for its own repairs. Then there will be no object in stopping a car at all, only to get them home as fast as they can. That would be the main idea. If each road is responsible for the repairs on its own cars, there is no object to stop for protection. The only reason for stopping them would be for safety, and that is what we ought to get into our minds just as thoroughly as we can, that as long as a car will run safely it should be allowed to run. As for this stopping on account of the small trifling expense, as Mr. Marden says, fifteen cents, and many cars have been stopped for that amount, and less too, why, anybody of common sense will say it is all nonsense to do it. A car gets a little damaged, and the fellow won't let it pass from the inspection point without he has a card given him. Well, they have a squabble about it, and the car is held for twenty-four hours while they quarrel about it, and finally somebody puts a card on, and it goes along, and

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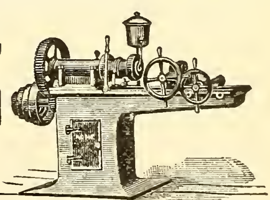

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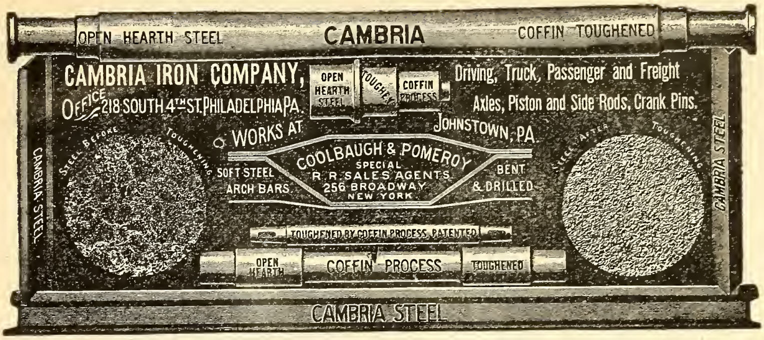
the consignee is delayed so long in the receipt of his freight. I could recite quite a number of instances where cars were held in Boston that did not go on their own road, where they had not to go more than a couple of miles, but they have stood four, five, and ten weeks, obliging the consignee to wait, and by and by a bill comes in for detention and delay, and somebody has it to pay.

Now, those things should be done away with ; and if we make each road responsible for its own cars, it seems to me that this motive would move them very largely, and I am fully satisfied that a majority of the country at the present time are entertaining that view, perhaps not as fully as that, but very nearly ; that is the prevailing opinion, and if we leave it to the general convention, we shall probably see a very radical change in the rules of interchange. It may not be as extensive as some of us anticipate, but it will be radically different from what it is at the present time.

The business of railroads and interchange of freight is just like every other business in this country. It has grown to an enormous extent, and we must have very different rules from what we had when the first rules were formulated that we are working under. It has been something like twenty-five years since we began to work under the rules of interchange ; and some time before that, perhaps, there was no interchange of cars at all. Many of the oldest men can remember when cars did not go off their own road ; everything was transferred. All you had got to do was to take your freight out and let your car go back, but that practice is all done away with now, and we cannot do business that way to-day, consequently we have got to have our cars move more rapidly. I should think that would be perfectly clear to anybody. While I would not advocate running an unsafe car, and it does not require a very skilful man to judge whether a car would be safe to run or not ; if only pieces of the ceiling are scratched off, or there is a little place broken in the roof, it would not injure its running safely, and there are hundreds of just such little things as that that cars are stopped for ; probably more than half at least, yes, quite two thirds of them are entirely unnecessary, and the car might just as well move as not.

I think that some of these men should get up and talk about it. I do not think it is hardly fair to come in here and pump Mr. Marden and myself dry. (*Laughter.*) The rest of them ought to say something to help us out. (*Applause.*)

The President. I do not think that the Club really wants to ask too much of Mr. Adams and Mr. Marden, but my idea is the Club is always very glad to hear those gentlemen speak on any subject, and I



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am inclined to believe that they are just as glad to do it. Now, there must be other men here in the car department — I cannot really single them out — who have some ideas which they are willing to express, and you need not be afraid to do that. Railroad men are not particularly critical about the kind of language that a man uses here, if he tells what he thinks and what he means, and railroad men generally are pretty apt to hit that mark when they try. There is no reason why others should not talk about it here as well as anywhere else. They should not let modesty stand between them and expressing themselves, and I hope they won't fail to do that on every occasion. The matter, of course, is an informal one here. As everybody knows who has anything to do with the movement of cars, there is a great chance to improve this interchange of car business. We all know that at the inspection points it is often a personal matter between inspectors on two different sides of the fence, one seeking to beat the other, as we call it, and if there was a car offered to one that had a scratch on it, or a nail sticking out, or something of that kind that was not important, he would set that car back, and they would quarrel over it two or three days, and freight would not be moved, and finally it would go to the head of the department, and he would have to come out and make peace between them and get that car moved, and the trouble would not amount to anything, but would only result in delay, traffic blockaded, and the yard work interfered with in more ways than one. Now all those cars that have those minor defects that do not interfere with the safe running of the cars would always find their way home to the owners, and my idea is with little danger of there being bills presented to the road for repairing those cars, because I believe from my experience that there is work enough to do without taking other folks' repairs in taking care of our own. When I was trying to work the car department I had fifty to seventy cars all the time in the yard waiting for necessary repairs, and a good many of them, I must say, were foreign cars, and a good many of our own were outside on some side track waiting to get in there. At that time I can assure you we did not want to take anybody's job in our own hands that we could get rid of, and I do not think the average railroad is so well supplied with men at the present time that they can do that.

I should really like to hear somebody say something on this subject. I see Mr. McAlpine here, superintendent of the Providence Division. He has always something to say, and we would like to hear from him. Mr. McAlpine, can't you enliven this meeting with a few remarks? We shall be very glad to hear you.

Mr. C. A. McAlpine. Mr. President and gentlemen, I think I

have a very good excuse for not saying anything on this subject, although it may be a little timeworn, and that is, that I came in wholly unprepared to say anything, but those of you who know me, and I think, Mr. Chairman, you should know that really that is not a good excuse for me, because I can talk just as well as though I had six months' preparation. I am not a public speaker, but still I am very much interested in what Mr. Adams and others have said. I do think it is a very important matter, and I think there is a great deal to be said in behalf of the operating department, although I am not competent or prepared to say it. You may have thought, Mr. Chairman, that I was like the boy down in Georgia, I think it was, as the story goes, who wandered into a town for the second time. On his first visit to the town it was for the purpose of attending a circus. On his second visit when he came into the town he noticed large tents spread out, and to his consternation he had not the necessary fifty cents to get in. He did not expect to see a circus, but he thought the matter over, and concluded he would go down and see if possibly he could crawl under the canvas and get in. Much to his surprise a very pleasant gentleman at the door invited him to walk right in, which he gladly did, and he went down to a front seat which was vacant, and, as perhaps you may have guessed, he had got into a Salvation Army meeting. The speaker had been trying to impress upon the audience the fact that every one present had got to decide that momentous question of his salvation once for all, and to illustrate his point he referred to the judgment day and to the sheep and goats; the sheep were taken and the goats rejected; and just as the boy got well into his seat the speaker said, "Who among you will be the goat?" There was no response, and he asked the same question the second time, and for the third time with a very impressive voice. The boy jumped up and said, "Mister, I never had much experience, but rather than have the show stop, I will be the goat." (*Laughter.*)

Now, you may have thought, Mr. Chairman, that rather than have this show stop, I would be willing to be a goat, but I am not. (*Renewed laughter.*) I wish I could, but I have neither the experience nor ability, but I do hope some one here representing the operating department will have something to say on the subject. We all have suffered enough about it.

The President. I see Mr. Robertson of St. Albans. He is a prominent man in the car department, and I know he wants to say something on this question of the revision of rules of interchange. Mr. Robertson, we shall be glad to hear from you.

Mr. W. J. Robertson. Mr. President and gentlemen, I am sorry I

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could not get here in time to hear the former discussion of this subject, for it is a question that has given me a great deal of concern in the last few years. This matter of interchange has assumed large proportions to us, especially in the matter of defects in cars. The defects that appear in the cars are owing to light construction. I won't say faulty construction, because it is supposed that every man who builds a car is building one to stand the usage that is required, and perhaps there are cases where cars fail from bad usage, and just the point where we should make the car owners responsible is the line that I think we should work upon. I think the owners of cars on private lines as a whole intend to have them built in a very thorough manner. That has been my experience in cars running over our lines, and I will say that when I have taken the matter up with such car owners the matter has been treated very considerately by them. They have authorized repairs at their expense where it was beyond any question proved to them that it was owing to the construction of the car that such cars failed. I think by taking up the matter with private lines it may be settled in many cases in that way, rather than have correspondence to a large extent, and settled perhaps by the Arbitration Committee of the Master Car Builders' Association. I think the car department of the Central Vermont for ten years past has never had a case that it thought necessary to submit to the Arbitration Committee. I am not prepared at this time to go through the rules and bring up certain questions that might come up later on in the convention. I do not think I can say anything more on the subject at this time, Mr. President. (*Applause.*)

Mr. Marden. Mr. President, as has been stated before by Mr. Adams, the leading question that is going to interest us at our next convention is the responsibility of car owners for defects in their cars. Now, I see here to-night quite a number of our foremen of shops and inspectors, and I would like to put the question in this way and see if we cannot draw out some opinion from them as to what in their judgment would be the result; for instance, most of them to-day are working under the rule that they must set back a freight car that is defective and unsafe to run, or if it is defective and safe to run, they must set it back or get a card for it, or in some way protect their road so that they won't be responsible for the damage to that car, providing it is delivered to some other road, and they demand that the repairs be made or a card given. Now, I would like to ask them their opinion, and I know they can give it; I know they have had experience; I know they know just as much about the movement of cars and detention of cars and inspection of cars as I do, perhaps more. I would like to ask them what in their opinion would be the result,

provided the car owners were made responsible for certain defects on cars, that is, the defects that were not caused by an accident on the road delivering the car, that the road delivering the car would be absolutely responsible for; what the result would be providing that rule was adopted, and in that case rather than set the car back they could take it and repair it, and charge that to the owner of the car, or if it was damaged on the delivering road, repair it and charge it to the delivering road. At present they will set that car back. Under the new rule they could take that car and repair it and charge it to the owner, and perhaps by an arrangement with the delivering road make such repairs as the delivering road was responsible for, and charge it to them. I think they could tell us what the result would be, how much it would forward cars, how much delay there would be, how much less trouble there would be between inspectors and delivering roads, and with your permission I would ask Mr. Sheffield of the New York and New England Road, whom I see present, and who has had quite an experience, to give his opinion as to what the result would be.

The PRESIDENT. I will say that I am somewhat at a disadvantage in not personally knowing some of these men who are here, and I am glad Mr. Marden has assisted me a little, and therefore I would ask Mr. Sheffield to say something for our benefit.

Mr. SHEFFIELD. Mr. President and members of the Club, I will say that I am no speechmaker. I have been connected with the inspection and repairs on the New York and New England Road for the past eighteen years. I have been at Worcester fifteen years as foreman, and I will say that we have a great interchange there, especially with the Boston and Maine Road, and we are getting along very nicely with them, although freight is oftentimes delayed for the want of cards to protect our company, especially going off our line; and by the arrangements that Mr. Adams and Mr. Marden speak of, if the New York and New England Road could take cars from the Boston and Maine, as they are the largest that we have to do with, and repair slight defects, it would forward freight at times from twenty-four to forty-eight hours, especially cars going West. We demand a great many cards from the Boston and Maine Road. Cars, we might say this morning, that could go forward by a noon train are oftentimes delayed until night on account of not being able to get cards for them to go forward in that train, and oftentimes cars that we get from the Fitchburg Road in the afternoon delivery we are unable to get cards from, and the consequence is cars lie over twenty-four hours.

I was very glad to hear some two or three months ago there was a

movement on foot whereby freight might be forwarded by light repairs being made by the company receiving the cars and not delaying the freight, for I think delaying the freight oftentimes gives the consignee a bad opinion of the road, and oftentimes he goes to a competing line to see if he cannot have the matter arranged differently, and I shall be very glad if at the next convention there can be something brought about whereby this freight can be forwarded without keeping the cars back for slight defects and having to stop the freight twenty-four hours in order to get a card put on the car for a slight defect which no reasonable man would ever charge for. Our greatest point of trouble has been at Hartford with the P. R. & E. people, and our people at Hartford have been obliged to give cards to the P. R. & E. people before the freight could be forwarded, and then the cars repaired would go to our general mechanic, and he would very courteously ask me why it was cards were not received and demanded, and I would explain that my men would think the card was not necessary, and if such were the case the freight would have to be delayed in order to get them. I hope the time will come when these minor things can be settled without cars being set back for slight defects such as grab handles, etc., which, if the road that received them would just slip one on, it would save perhaps \$2.50 to \$3.50 to the company by transferring the cars. Oftentimes we have such things come up, and our agent has asked me if I could not have those repairs made so the freight would go forward on the next train, and that would save a delay of twenty-four hours. I do not know as I have anything more to say, gentlemen. (*Applause.*)

The President. I see Mr. Rifenburg, of the Fitchburg Road and we want to hear from him.

Mr. W. D. Rifenburg. Mr. President, I have been very much discouraged in regard to the inspection of cars. I find there has been a great deal of conflict between the inspectors of the several roads running in and out of Worcester. There was a time when we used to have as many as fifty and sixty crippled cars there that were refused by the connecting lines, and at the present time there is a mode of interchange between the Fitchburg Road and the New York, New Haven and Hartford there whereby they do the repairs and charge to the Fitchburg Road those that are chargeable to that road, and the Fitchburg Road does the same by them. That started Sept. 1, 1894, and I went over the record in the office to find how many cars had been transferred, and I found it cost our company two hundred dollars for transferring freight from Sept. 1, 1893, to Sept. 1, 1894, when this mode of interchange took place. At the present time the

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transfer of freight from broken cars is nothing in comparison with what it was, and everything is going along now very smoothly. Of course, this demurrage law that went into effect a short time ago has helped us out considerably. There was a time when our yard was full of cars that would perhaps lie there from three to six months, loaded with hay and grain, what we call dead freight, and those cars would have to be switched, perhaps, every day, and that caused a great amount of yard breakage. I remember one month the yard breakage in Worcester was somewhere in the neighborhood of five hundred dollars. At the present rate we would not get five hundred dollars' worth from breakage in five years. I do not think that we have had a dollar's worth of yard breakage the last month. I cannot recall any large breakage. I do not recall anything in the shape even of a drawbar. Some few things have broken, and I think that in the revision of the rules, especially Rule 8, it should cover all defects. Now, to go into details a little, timber bolts and all bolts of cars are chargeable now to the road running the car. You take those bolts out, and you find that they have been broken, perhaps months and years, perhaps from a shock by coming in contact with other cars. Those cars may be loaded with corn or oats, and perhaps it might cost a couple of dollars to repair them, and the consignee would give us in the neighborhood of twenty-five cents. I cannot think of anything more that I can say now, but I would like to be able to say more to you.

Mr. Adams. Mr. President, I would like to say one or two words more in relation to this idea of making roads responsible for their own breakage. The principal difficulty about this matter in the minds ot most of the men in charge of the mechanical department is this, the liability of having breakage charged to a road where it was carelessly done, breakage that a road would be absolutely responsible for by unfair usage; that is the great obstacle to overcome in making a new set of rules. Just how to define that class of breakage that comes under the head of carelessness, perhaps that would be a proper term to use, may be difficult. Everybody who knows anything about railroading knows that there is a great deal of careless breakage, and a good deal more of it perhaps than some of the officers know of. It does not take a great deal of excitement to get men a little worked up, and they will give a motion to come back carefully, and they come back a good deal harder than they mean to, perhaps, and they knock the drawbars out or break other things, and the consequence is that each road is fearful that charges will be brought against them for repairs of this character. Now if there can be any way devised by which they can get that class of breakage defined so that there will be no difficulty

about settling that question, I do not think there will be any difficulty whatever in bringing about a change of the rules of interchange so as to make roads mainly responsible for their breakage, or responsible for all breakage that is not a result of accident or carelessness. Of course, if we should derail a train we would not expect to ask anybody to pay for repairing the damage. We should consider that to be our own fault and misfortune and fix it up, for nobody would think of asking anybody else to pay for it; but there is a great deal of breakage in yard switching that would be entirely unnecessary if there was a little more care used. In the last year or two the increased weight of engines has been a serious injury to cars. A heavy switch engine breaks up a great many more cars than a light one. That has been my experience, and I guess the experience of everybody. Whether the engineer does not calculate how much weight he is throwing back against that train, or what the trouble is, I am sure I do not know, but it seems to me there might be a good deal more care taken about those matters, and I have sometimes felt as though our men directly in charge of the men in the transportation department did not quite come up to their duty by making them come to time a little better. These fellows that handle trains that way do their work very carelessly, and when damage is done, if you say, "What did you do that for?" they say, "Oh, it only came up just so as to barely touch it." Now, no road ought to be asked to repair such damages as that, and the difficulty that all these clubs have found in discussing that, especially the Western clubs, and they go into that thing very carefully too, and they have got some very bright men out there who know about those things as well as we do down here in the East, — the principal thing is to fix the precise point of defining the breakage in such a way that they can make each road responsible for its repairs as a rule; and I hope that this committee that has this matter in charge will devise some plan whereby this can be done. I believe Mr. Leeds is the chairman of that committee; he is a man of good resources, and I expect the committee will formulate a plan of interchange that will suit us all, and I hope we will be able to agree upon it at our general convention so that we will have a great improvement in the movement of freight hereafter. There is no sort of doubt, I think the evidence is perfectly conclusive, that delays have been great, and consignees have had great reason to complain many times because their freight was not delivered to them in reasonably good time, when delays might have been avoided by inspection, if the cars had been allowed to go along.

I do not know that we could blame the inspectors at all under the present rules of interchange if they did not allow cars to go by that en-

tailed upon their own company unnecessary expense, for which they would be blamed, consequently they have got to stop them, and undoubtedly they stop cars unnecessarily that might be allowed to go safely. For fear of neglecting their duty they are too careful perhaps, and the consequence is that freight is delayed. But I am very glad indeed that our mechanical men are taking a little broader view of this thing than they used to, and are looking at it from a different standpoint, which is safety without so much regard to protecting each other from being beaten.

The President. We have here Mr. Kelson, from the Canadian Pacific Road. I should be glad to hear something from Mr. Kelson.

Mr. Kelson. Mr. President and members of the New England Railroad Club, I did not come here to talk, but to listen. I was not expecting to be called upon for a speech, but I am very glad to be here to-night, because this is the first time I have ever met with you. We have a little road up our way, and I do not know but if our master mechanic were here he could tell you more about interchange of cars than I can. I do not know whether your meeting occurs once a month or once in three months, or how often, but certainly what I have heard to-night has been very interesting, and yet, do not think you know all about it. Certainly as far as we are concerned, our people have not a great deal to do with the New England Railroad Club. I think it would be a good thing for you to come to Montreal occasionally. Although I come to Boston occasionally, I think a few days more here will be enough, and if a Fitchburg train goes to-morrow night, I am going home. Mr. Medway thinks I better go sure Good Friday. (*Applause.*)

The President. I will say to Mr. Kelson that the New England Railroad Club meets the second Wednesday night in the month, every month in the year, excepting June, July, and August, and the Club will always be glad to welcome him at any time he is in Boston.

The President then called upon Mr. Fraser, who desired to be excused from making any remarks, and there being no further business the meeting adjourned, 9.45 P. M. Seventy-seven members present.

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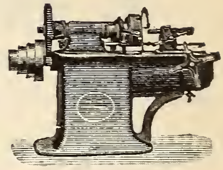

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New England Railroad Club.

Electrical Apparatus

IN CONNECTION WITH

SIGNALING AND MOVING OF TRAINS.

PAPERS BY

J. V. YOUNG, AND J. P. COLEMAN.

Meeting of May 8th, 1895.

Published by the Club,
EDWARD L. JANES, SECRETARY, P. O. BOX 1158, BOSTON.

Next Meeting, October 9th, 1895.

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F. D. ADAMS, President	March,	1883,	to March,	1885.
J. W. MARDEN, President	"	1885,	"	1887.
JAMES N. LAUDER, President	"	1887,	"	1889.
GEO. RICHARDS, President	"	1889,	"	1891.
FRED. M. TWOMBLY, President	"	1891,	"	1893.
JOHN T. CHAMBERLAIN, President	"	1893,	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Wednesday evening, May 8, 1895.

The meeting was called to order at 7.50, President L. M. BUTLER occupying the chair. The minutes of the last meeting were approved as printed.

The PRESIDENT then called for a report from the committee on the Constitution and By-Laws, but that committee not being ready to report, the next business was the report of the committee on Mr. Lauder's picture.

Mr. F. M. TWOMBLY. Mr. President, your committee has procured a picture of Mr. Lauder at an expense of $25 for the picture and $10 for the frame, and ask you to accept the same.

The picture was then placed upon the platform and exhibited to the meeting.

The PRESIDENT. Gentlemen, you have heard the report of the committee, and you have an opportunity to examine the picture. What is your pleasure?

Mr. ADAMS. Mr. President, I move "That the thanks of the Club be extended to the Committee for their work, and that the picture be accepted.'

The motion was seconded and adopted.

The President then announced the death of Mr. Charles Richardson, Treasurer of the Club, which occurred on the 29th of April, and stated that Mr. C. W. Willis, a member of the Club, would read a paper upon the life and work of Mr. Richardson.

Mr. C. W. Willis. Mr. President, and members of the New England Railroad Club: as a friend of the late Treasurer of the New England Railroad Club I knew Mr. Richardson well. He always had the best interests of the Club at heart, and was loyal to it, as he was to every organization to which he belonged, and to every person who claimed his friendship. He was greatly interested in his recent election to the office of Treasurer, and had he lived the office would have been filled faithfully and well. The brief sketch of Mr. Richardson which I am about to present was not prepared for this occasion, but is a sketch written in my editorial capacity, and treats of him, not as a member of this Club, but of his life and life work in the commercial field in which he was engaged in trade for almost half a century. I trust, however, that it will be none the less acceptable on that account, and I will now proceed to read the sketch, which is a proof of the unpublished article.

CHARLES RICHARDSON,

BY C. W. WILLIS.

He was one of the best known and most highly respected merchants of Boston, and his memory will long be cherished as a man whose life was spotless, whose character was without a blemish, and whose heart was truly right. His character was reflected in his daily life, and his conduct toward his fellow men was always in strict accordance with the teachings of the Golden Rule.

There was no member of the paint and oil trade in the United States who was more universally known and respected, or who has been more zealous and untiring in his efforts to elevate the ethics of business than Charles Richardson.

While quite a small lad he lived on a farm in the town of Framingham, Mass., and when but about fourteen years old he went from farm to store. His education at this early age had, of course, been confined to the country school in the district where his parents resided. On entering the store, the understanding on the part of his father was that he should have a certain amount of schooling; but, as was the case with many another country boy of those days, the hours of labor were more than those devoted to school and boyish pastimes, the result being that he was accorded but a single term at the academy in Framingham. The store where he received his first business experience was a country general store, and among the many articles sold there were paints and oils.

In 1849 he made an arrangement with John N. Dennison & Co., whose place of business was at 103 Milk street, Boston, wholesale dealers in dry goods and clothing. This house was a conservative and very highly estimable one, Mr. Dennison being one of the old line

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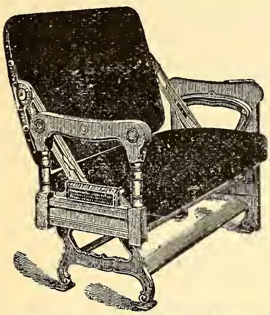

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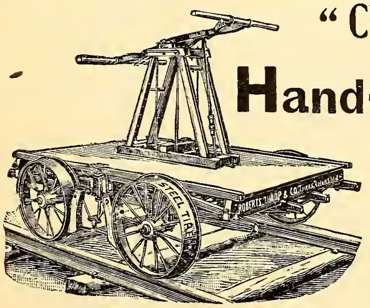

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Boston merchants, whose sterling integrity was proverbial, upright and exacting to a degree. The young man and future merchant was accordingly, at the very outset, surrounded by the very best of influences, and his first intentions were moulded by the highest examples of strict business ethics, which so well fitted him for a future career. For this house Mr. Richardson made his first trip in the State of Maine, in 1849.

Subsequently certain changes transpired in the firm, and at the same time an opportunity was offered Mr. Richardson to engage his services to William C. Hunneman, Jr., dealer in paints, oils, etc. After three years in Mr. Hunneman's employ, Mr. Richardson purchased his interests in the business and started out on his own account under the firm name of Charles Richardson & Co. His business prospered and increased, so that in a very few years he was obliged to seek more commodious quarters, which were found at the corner of Milk and Broad streets. While here he narrowly escaped being burned out in the great fire of 1872, and soon after moved to the present quarters of the firm of Charles Richardson & Co., 85 Oliver street, where they occupy an entire building of large dimensions.

Mr. Richardson was always deeply interested in association work and organized effort in business, and it was most largely due to his efforts that the Paint and Oil Club of New England was formed, which was the nucleus of the paint and oil trade organization in this country. When, as far back as 1867, a feeling among the paint dealers of Boston that it would be a good plan to form a trade organization, culminated in the organization, in 1871, of the Boston Commercial Association, Mr. Richardson was chosen its president.

This organization, from lack of any special object in view, was finally disbanded. The death of a member of the Boston Commercial Association occasioned a gathering of the members of the trade, when Mr. Richardson drew attention to the fact that an organization on a business and social basis would be a good thing. A commitee was appointed to take the matter again under consideration, and a meeting was held on February 23, 1884, at which time the Paint and Oil Club was formed and officers chosen, with Charles Richardson as its first president.

From that time he was unceasing and untiring in his efforts to benefit the trade. In office, and on many important committees, he has done valuable work, and the trade, not only of Boston and New England, but of the whole country has reaped the benefit thereof. One of the most successful and beneficial features of the Paint and Oil Club of New England, the Credit Bureau, was conceived by Mr. Richardson, and it was his labors that placed it on its present basis, conceded by every member of the club to be invaluable.

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Mr. Richardson attained wide prominence in his activity in the prosecution of the adulterators of turpentine, making it so interesting to them that adulterated turpentine has been completely driven from New England.

When the National Paint, Oil, and Varnish Association was formed in Saratoga in July, 1888, Mr. Richardson was elected its first president, and was re-elected to a second term at Cleveland in January, 1889, and a third at the convention in Detroit in January, 1890. He was nominated for a fourth term at the Cincinnati convention in December, 1891, but declined to serve.

Since then he lost none of his interest in the National Association, and rendered valuable service as a member of the Board of Control on various committees.

The most notable service which he has in latter years accomplished is the promotion of the idea of the establishment of a new cabinet office, to be called the Department of Trade and Commerce; and, as chairman of this committee of the National Association, he awakened such a widespread interest throughout the country, with business men and the press, that the ultimate success of the measure does not seem far off.

As a citizen, Mr. Richardson was not only a leading citizen of Boston but he has an unbroken record as a patriotic American. He numbered among his friends and associates such men of national renown as Theodore Parker, Wendell Phillips and William Lloyd Garrison; and to the day of his death he was on terms of friendship with nearly all the prominent men in the Commonwealth.

The world should be made better from the presence of such a life as that of Mr. Richardson — but the world and the majority of the people in it seem almost incapable of being benefitted by such a life as his.

Mr. Richardson literally died from the effects of overwork, that occasioned by his own business, and in laboring for others, to aid others, and to uplift and benefit the trade in which he was engaged. He was generous and untiring in his efforts to uplift the ethics of business. But, alas, he labored much alone. He loathed dishonesty of every kind, name and nature. He as greatly loved honesty and honor.

He was a philanthropist in the highest sense of the word, but he gave unseen by men.

There was nothing that was to him too great a task to perform for a friend; and the last thing he did on earth, before he was taken ill, was a service for another.

There were few like him — none.

The writer, who had, perhaps, been his nearest and most intimate friend, next to his immediate family and his business associates of his firm, can truly say: "I have lost the best friend I ever possessed."

The PRESIDENT. It is with much regret that I am obliged to announce the death of another member of our Club, Mr. John W. Sampson, of Providence, a man connected with the old Boston & Providence Road, and later under Mr. Lauder's administration as travelling engineer.

The next item of business will be the election of a Treasurer.

Mr. JOHN KENT. Mr. President, there is no one in this Club but must revere the memory of our late Treasurer and regret his untimely decease. The nomination of his successor has perhaps been very properly left to the Finance Committee, and I am able to say that the committee has been fortunate enough to secure a promise from Mr. Charles W. Sherburne that he will serve the Club as Treasurer for the ensuing year; and in behalf of that committee it is my pleasure to present his name for election.

The nomination was seconded; and by the unanimous vote of the members the Secretary was instructed to deposited one ballot in behalf of the Club for Chas. W. Sherburne as Treasurer. Ballot cast by the Secretary.

The PRESIDENT, I have here a communication from the New York Railroad Club. It refers to something that is new to me. Our Secretary will read it.

The Secretary then read the following communication:

SECRETARY'S OFFICE, NEW YORK RAILROAD CLUB,
256 Broadway, New York, April 27, 1895.

PRESIDENT NEW ENGLAND RAILROAD CLUB,
Care of MR. E. L. JANES, Secy., Boston, Mass.

Dear Sir: — Enclosed please find proof of a resolution that was passed at the last meeting of the New York Railroad Club, which will explain itself.

This is sent you with the hope that at the May meeting of your club a committee may be named to meet the committee of the New York Railroad Club, at Thousand Islands, to formulate the plan as set forth in the resolution. There can certainly be no objection to a properly authorized committee meeting and talking this matter over — whatever action is taken finally.

Yours very truly,
JOHN A. HILL, *Secretary*.

Whereas, It has been customary in the past at the annual conventions of the Master Car Builders and Master Mechanics to raise by subscription a fund for the entertainment of the members of the conventions while in session; and

Whereas, There are now in the United States six railway clubs similar in their organization to our own; and

Whereas, It is entirely within their province to provide such a fund, and do away with the present mode of collecting assessments; therefore be it

Resolved, That the chairman of this meeting be hereby instructed to appoint a committee consisting of three members of the club, and that the New England, the Central, the Western and Southern, Southwestern and the Northwestern Railway Clubs are each hereby invited to appoint similar committees to meet the one to be appointed by the chair at Alexandria Bay during the coming convention, to devise the best means of arranging for such subscriptions and entertainments, and that a copy of this resolution be sent by the secretary to each of the clubs named.

The PRESIDENT. Gentlemen, you have heard the resolution; what action will you take upon it?

Mr. ADAMS. Mr. President, this seems to be a new departure. I do not know but it is a good one. I am not prepared to say. There never has been before any question of this kind brought before the Club in any form whatever. The entertainments that we have had at our conventions have been very pleasant, the most of them, and I do not know as we ought to criticise them in any way. I suppose they have been voluntary so far as the membership is concerned; at least, so far as my knowledge goes they have all been voluntary. Nobody was asked, that I know of, to give entertainments, and I do not know as I can quite see my way clear to fall in with this view of things. I enjoyed some of the entertainments; some of them were very fine, and I do not know but it should be done by the railroad clubs, but it seems to me rather an unexpected thing, and I am not prepared really to fall in with it just at present. If the rest of the members all agree, I do not know as I should raise any objection against it; but it strikes me it is a very marked change, and I am a little surprised at the movement of the New York Club. It seems to have originated with them; and they are asking other clubs to join with them.

Mr. CHAMBERLAIN. Mr. President, I think probably the least said about this matter is the best. I move you "That the Secretary be instructed to notify the Secretary of the New York Railroad Club that we deem it inexpedient to appoint a committee."

The motion was seconded and adopted.

Discussion by Messrs. Marden, Chamberlain, Sewall and Adams, as to the advisibility of printing in the reports the domestic affairs of the Club then followed, and upon motion of Mr. Chamberlain it was voted, "That all matter pertaining to the local interest of the New England Club, which might be called of a private nature, be left discretionary with the Secretary whether to print in its proceedings or not."

The motion was seconded and adopted.

The PRESIDENT. Is there any other business to be brought before the Club at this time? If not, we will proceed to the subject for the evening's discussion, "Electrical Apparatus in connection with Signaling and Moving of Trains." We have some papers to be read. The first, by Mr. John V. Young, will be read by Mr. T. B. Purves, Jr.

Edward Cliff, Pres't and Manager. John C. N. Guibert, Sec'y. H. D. Force, Vice Pres't & Treas.

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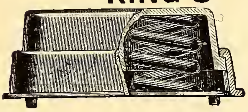

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RAILROAD SIGNALS AND SWITCHES.

PAPER BY JOHN V. YOUNG. READ BY T. B. PURVES, JR.

The matter of Block Signals and Interlocking Switches and signals is of interest to all railroad men.

By the block signals the engineer is safely guided on his way and informed at all times of the fact whether it is safe for him to proceed or whether he should use extreme caution in proceeding, and be on the lookout for obstructions in the way of a train ahead in the block, or switches not properly set for his track. By the interlocking system of switches and signals he is safely guided through the large number of switches located at yards, junctions, etc., and knows for a fact that when he receives the clear or safety signal that all switches over which the signal leads him are properly set and locked for his train.

The different systems of block signals in use in this country are divided into Automatic Electric Block Signals, Electric Controlled Manual Block Signals, and Simple Manual Block Signals.

One of the first Automatic Electric Block Signals which were adopted by a number of Railroads in this vicinity were controlled by track instruments. and were arranged on what is known as the open circuit principle. The signal consisted of a large red cloth disc located in what is known as a banjo box. This signal looked like a large banjo in an inverted position. In the centre of the box or case was a circular hole covered with glass. The disc was arranged on an arm which was pivoted in such a manner that the disc could be dropped down and cover the hole in the box, so that the engineer approaching it would see the red disc and be governed accordingly.

When it was desired to show safety the disc could be lifted up in the box out of sight, leaving the opening clear.

The manner of operating the disc was as follows:

Attached to an arm carrying the disc was a small drum. On this drum was coiled a small flat link chain, one end of which was attached to the drum and the other end attached to a small brass tube. In this tube was a spiral spring which was held from slipping out of the tube by a small cap over the end of the tube. Through this cap a brass rod was passed up through the centre of the spring. This rod was provided with a collar, so that when the rod was pulled the spring would be compressed. The other end of this rod was attached to the armature lever of a powerful electro-magnet and was so arranged and adjusted that when this magnet was charged and the armature attracted the rod was pulled, which conveying its movement to the tube through the spring, the tube would cause a tension to be put on the small chain,

causing it to unwind from the drum. This would cause the drum to revolve and lift the arm carrying the disc and the disc would be lifted up inside of the case and uncover the opening in the case, thereby giving a clear signal. As the signal worked on an open circuit, the circuit on the magnet was closed for only a short time, so a latch was provided to hold the armature against the cores of the magnet after it had once been attracted. This latch was controlled by, and really formed a part of, the armature of a second electro-magnet. When this second magnet was charged the latch would be removed and the signal would naturally drop to the danger position. In applying these signals they were located wherever thought necessary and near each signal was located a track instrument. This instrument controlled the circuit to the latching magnet. At the further end of the block was located another track instrument which controlled the circuit to the large magnet that set the signal at clear. Where these signals were continuous it was necessary to locate the clearing track instrument beyond the next signal a sufficient distance, so that the first signal would not clear until the train had passed the second signal some distance, this being called the overlap, meaning the overlapping of each signal beyond the one in advance of it. As it was quite difficult to locate this clearing track instrument so as to have each signal remain at danger until the rear of each train had passed a certain distance beyond the next one in advance, owing to the fact that the trains were not always of the same length, and the track instrument was operated by the forward wheel of a train, it was customary to help the system out by locating in advance of the block a signal using a disc of green or blue. This signal was operated in connection with the positive or red signal. These signals required a large amount of battery power to operate them, and it was customary in applying them to locate a large number of cells at some central place, and run a main battery wire and a return wire over the whole system, and tap on wires wherever it was desired to use the current. In this system the operating was as follows: the train entering the block would operate the track instrument which controlled the latching magnet circuit; this would cause the magnet to be charged and attract its armature, which, in turn, would release the armature lever of the large magnet, thereby allowing the signal to drop to the danger position.

As the train passed out of the block the passing of the wheels over the second or clearing track instrument would operate that instrument and close the circuit on the large controlling magnet, which magnet would attract its lever, thereby clearing the signal, which was immediately latched clear by the armature of the latching magnet until released by a second train. These signals were also controlled from attachments at each switch so arranged as to set the signal at danger when the switch

was thrown from the main line. As there were times when the trains would enter and remain there for some time, making it desirable to clear the signal in the rear, after the switch had been reset for the main line, there were generally boxes near the switch containing instruments by which this could be done.

These signals were a great improvement over the old method of running without signals and depending entirely upon time tables; but it was found there were a number of weak points in the system. A few of these were as follows:

The signals being on an open circuit, should anything happen to them, or the battery wires become crossed, forming a short circuit for the battery, or anything happen to the main battery, there was a chance of the signals remaining at all clear when they should show danger. Another weak point was the fact that the forward wheels of the train were the ones that really performed the work; the rear wheels of course passed over the track instruments, but the work had already been performed; and in case of a train breaking in two, should the forward end pass over the clearing track instrument and then back up again, there was a clear signal behind the train. This system, with let down or clearing instruments at the switches, also required that the train-men be posted on the manipulation of these instruments.

Another objection to this system was that should two trains be in the same section, caused, we will say, by the first train moving slowly, and the second train after waiting at its signal the proper time and then proceeding cautiously into the block, the passing out of the first train would clear the signals behind the next train.

After the above signals had been in service a short time inventors began to turn their attention to experiments in the line of Automatic Signals and the use of the track as a conductor was begun.

The knowledge of electricity and what could be done with it was not up to its present state, and the idea was held up in ridicule by some of the men who were considered experts in electrical matters. They claimed that the electrical current would be lost in the ground. One Supt. of Telegraph, said that he was so sure the track could not be used in the manner intended that he would be willing "to eat his shirt if it could be." The track circuit had, however, come to stay, and I have never heard of his living up to his agreement. In using the track to form a part of a signal system, the rails are connected at each joint by a wire fastened to one rail, generally by some form of rivet driven into a hole, and the other end of the wire fastened in the same manner to the next rail. In the early experiments it was soon found that the ordinary splice bar did not form a good electric contact with the rails and it was necessary to put on these track wires to insure a good electric

connection between the rails. All the joints in the section to be protected are joined in this manner.

At each end of the section the rails are insulated from those beyond, by either putting on wooden splice bars or putting a sheet of fibre between the iron fish plate and the rail.

At the further end of the section is located a battery consisting generally of not over two jars. The poles of this battery are connected to the rails so that the rails are used as conductors to a relay located at the other end of the section. The magnet of this relay is connected to the rails. By this you will readily see that when the current of electricity is not interrupted the magnet of the relay will be charged. The local or contact points of the relay are then made to control a battery, which in turn controls the mechanism of the signal. This mechanism can consist of any suitable arrangement whereby the signal banner or blade can be caused to revolve, or be lifted and lowered, the movement being controlled by a magnet, the battery for which is controlled by the track relay.

Some of the first signals consisted of a banjo case similar to the ones used in the system before described. In these banjos was located a clockwork, which caused the red cloth disc to revolve on a suitable pivot.

The revolving of this disc was controlled by the armature lever of an electro-magnet. When this magnet was charged and the armature attracted, the disc would stand edgewise to the engineer and signify "All Clear."

When the circuit on the magnet was broken, the magnet would become demagnetized and the armature fall back from the cores of the magnet and allow the signal disc to make a quarter turn, thereby showing its surface to the engineer and indicate "Danger."

As all the work the signal battery had to perform consisted of charging a small magnet which controlled the movement of the clockwork, it will easily be seen that this was an improvement on the other system, as a very few jars of battery were needed, generally about two, and the signals could be located at isolated or bad places without going to the expense of a large number of cells.

Again, as each signal had its own battery, should anything happen to that battery only the one signal would be affected, and as it required the battery power to hold the mechanism in the safety position, the absence of the current would allow the signal to assume the danger position, which is on the safe side, as it is much better to stop a train without there being danger ahead, than to let it proceed when it might be dangerous to do so.

By an arrangement of circuits where the block signalling is continuous, each signal remains at danger after a train has passed it until the rear of

the train has passed a suitable distance beyond the next signal in advance. The circuit through the track is controlled at each switch by a circuit controller operated by the switch. This circuit controller or switch-box is so arranged that when the switch is thrown from the main line, the track circuit will be broken and a short circuit put upon it. This causes the relay controlling the signal to be discharged and cause the signal to assume the danger position.

When the switch is restored to the main line, the switch-box closes the track circuit at that point, and provided there is no train upon the track section, the relay will be again charged and cause the signal to assume the safety position. This you will see requires no additional work by the train-men. The rails of the side track between the point of the switch and the fouling point are also electrically connected to the main line, and should a train car or pair of wheels be left between these points, thereby being dangerous to trains passing on the main line, the signal will remain at danger till this obstruction to traffic is removed. After a few of these signals had been in service a short time the system was greatly improved by the invention of a new signal machine driven by a one hundred pound weight.

This machine was powerful enough to operate a banner that was exposed to the weather instead of being covered up in a case with a glass front. This overcame a very serious objection to that form of signal, for in this climate the glass will become covered with snow at times and prevent the engineer seeing the disc. With the disc exposed the engineer can easily see the position it is in should there be a coating of snow all over it. The operating of this system is briefly explained as follows. We will assume that everything is in proper shape and the signal stands at "All Clear." The current from the track battery is flowing down one rail, up through the magnet of the relay and back on the other rail to the battery. The relay magnet is charged, attracting its armature and causing the battery of the local or signal circuit to be closed on the signal magnet, which in turn attracts its armature and allows the signal mechanism to assume the safety position. The train approaches the signal and enters the block section. Now, electricity, although one of the swiftest agents employed by man, has a sort of lazy streak; or in other words always take the shortest course, and in speaking of the shortest way we mean that which offers the least resistance. It being much less resistance from the rail to the car-wheel, car-wheel to axle, axle to the other wheel and hence to the rail, than through the large number of turns of copper wire upon the relay magnet, the electrical current immediately takes that course, thereby causing the magnet to be discharged and release its armature.

The armature being released, breaks the circuit of the signal battery upon the signal magnet, which is immediately discharged.

This allows the signal mechanism to assume the danger position. When the train has passed entirely out of the block section, the current of the track battery is again allowed to flow through the relay magnet, causing it to be charged, attract its armature, close the circuit upon the signal and cause it to assume the safety position.

A few of the advantages of this system over the other are as follows: the signal remains at danger until the last pair of wheels pass entirely out of the block. The signal is out in the weather and will not be obscured by snow being on the glass. Should anything happen to the batteries the signal will assume the danger position. The signals can be located at any dangerous point without the expense of a large battery. The movement of a switch from the main line will set the signal to danger, and moving the switch back again will clear the signal, provided, of course, the track is clear from obstructions. The moving or breaking of a rail will cause the signal to show danger. Crossed wires cutting off the battery from the signal will cause the signal to assume the danger position.

A form of signals that has been adopted by a number of railroads, consists of a semaphore arm located upon a suitable post, and is known as the Westinghouse Pneumatic Block Signal System.

A small air cylinder is fastened to the post, and the piston rod of the cylinder is connected by means of a suitably arranged connecting rod to the semaphore blade. Above the cylinder is an electric magnet controlling an air valve. When this magnet is charged the valve is open and when discharged the valve is closed and exhaust is open. At some suitable place is located an air compressor which compresses the air to about seventy pounds pressure per inch. From this compressor pipe is laid alongside of the road-bed either in the ground or on stakes.

From the air pipe branches are led to each signal and the air to the signal mechanism is controlled by the electric valve. The battery operating the electric valve is controlled by the track circuit relay in about the same manner as the clockwork signal.

In the majority of places where this system has been applied distant signals are located on the same posts as the home signals, and are controlled from the next signal in advance, so that the engineer is notified one block ahead at all times of the condition of the next block he will enter.

This system uses the semaphore signal, which is considered by the majority of railroad men as being the only proper form.

The simple manual block system consists of some form of signal, generally semaphore, located at the stations and telegraph offices along the line of the road. These signals are operated by a lever or cord and are pulled to safety by the station agent or operator when it is desired to

have the train enter the block. After the train has passed him he notifies the man in the rear of the fact.

While this system is better perhaps than no system at all, there has been a number of cases where there has been pretty bad wrecks caused by rear end collisions.

You might ask how this could happen, as the operator of course would not send a train into the block until he had been advised that the preceeding train had passed out. The fact is that a number of, or in fact the majority of these wrecks have occured in the night time.

Of course men are apt to fail in the discharge of their duty and, especially at night, dose off to sleep, after having notified the man in the rear that the block is clear. The train starts toward him and while he is taken a quiet nap a train passes perhaps on the other track; this wakes him up and he immediately notifies the man in the rear again that the block is clear. This man allows a second train to enter the block. The first train possibly has met with some trouble and stopped. Along comes the second train, there is a crash, and the newspapers says that somebody blundered.

The Electric Controlled Manual Block System was invented to overcome this defect, and to put a check upon such operators.

The first of these that I had experience with is known as the Sykes System, who received what is known as a broad patent, covering any system whereby one man unlocked the signal lever of the signal man in the rear.

This patent has since run out, and there are a number of systems in use which are considered an improvement on the original Sykes System, but which necessarily embody the feature of A unlocking B.

In the Electric Controlled Manual Block System there is what is known as a lock and plunger for each track in each signal cabin or tower. The lock is attached to the signal lever and prevents the lever being pulled to the safety position unless unlocked by the signal man in advance. The plunger is also either connected to the same signal lever or controlled by it, and prevents the signal man from unlocking the signal lever in the tower in his rear for a second train until he shall have cleared his signal, the train passed by him and he has restored his lever to the danger position.

As his lever is unlocked from the tower in advance he can not again clear his signal until he is unlocked by the signal man in advance, who can not do this until he has been unlocked by the signal man in advance of him, the train passed and signal lever restored to the danger position, and so on through the system.

With this system, however, the operator at the beginning of a system could leave his signal at safety after the train had passed, which would

not require the signal man in advance to unlock him ; and through the whole system the same could be done and all hands take a quiet nap. Inventors, however, were not going to let this happen if it could be prevented, and the electric slot was invented. This is an electric attachment put in the connecting wire between the lever and the signal and controlled by a short section of insulated track.

When the train passed over this section, the signal wire would be uncoupled and the signal would automatically go to danger, making it necessary for the signal man to put his lever back to couple the wire, and the lever would immediately be locked back until unlocked again by the signal man in advance, who could not do so until the train had passed him and he had put his lever in the danger position, where it was immediately locked until again unlocked by the signal man in advance. As this would not prevent the operators from all clearing their signals after a train had passed over the system, and then taking a nap until the next one had passed, inventors went another step forward and arranged the system so that each signal can only be cleared when there is a train actually approaching it.

In this system the operator is supposed to notify the signal man in the rear when a train has passed out of the block, and also notify the signal man in advance when there is a train approaching him. This is usually done by means of a certain number of taps on a bell. There were, however, a number of instances where trains were stopped at the signals, and at the investigation of such stops the operator who had stopped the train would claim that he had not been notified of its approach, and did not know it was coming until he happened to look out of the window and saw it. The operator in the rear would of course say that he had notified him, and it was a question as to which was telling the truth.

The system was still further improved by arranging an indicator that would show in the tower a card with the words on it, "Train in Block," when a train had passed the tower in the rear. This prevents such a controversy between the operators, for the question can be asked the operator who stops the train "What did your indicator say?"

This does not do away with the bell code, and is simply an additional safeguard to guard against stopping trains when there is no occasion to do so. From the above you will see that there is now a system where, 1st, there can not be two trains in the section at the same time, unless a second one enters against a red signal. 2nd, the signal can not be cleared until the lever has been released by the signal man in advance, and there is a train approaching to use that signal. 3rd, there is automatic announcement of the approach of the trains, so that the signal men have no excuse for stopping a train, claiming that he had not been notified of its approach.

Another arrangement of signals and switches, in which electricity plays an important part, is the system known as the Westinghouse Electro Pneumatic Interlocking System. In this system the heavy work is performed by compressed air, but all the valves and indicators are operated by electricity.

By this means, switches are moved very quickly and safely and we are thereby enabled to increase the traffic at a large place such as a terminal, and handle the same promptly and with satisfaction to all concerned.

One of the largest systems of this kind has been erected at the Union Station, Boston, a place well-known to the members of this club, and a description of it written by Mr. J. P. Coleman, Asst. Engineer of The Union Switch & Signal Co., will make the method of operating trains by that system, clear to all members.

The PRESIDENT. We have with us the evening Mr. Robert J. Sheehy, who has made a study of railroad signaling, and he has something which he will now present to us.

REMARKS OF ROBERT J. SHEEHY.

Mr. President and Gentlemen: — Inasmuch as the matter of signals has been discussed this evening, I am glad to have an opportunity of speaking to you about an Automatic Signal System which I devised some years since and which I am now bringing to the the attention of the railroad people of this section of the country. While the signal systems heretofore devised and used have been and are, of course, much better than no signals at all, yet all will admit that there is room for improvement in that direction, and for an automatic system of an entirely different character.

Some years ago, I devised an automatic system of signals wherein I placed the signal devices in the cabs of the locomotives and made use of the rails on which the trains run as conductors to indicate to the engineers the condition of the blocks ahead. When I devised this system, I found that I was rather ahead of the times, for the reason that no suitable batteries or current-producing devices where then provided to properly operate the same. Again, I found that the system was such a radical departure from those in public use at the time that few people were sufficiently conversant with electrical appliances to enable them to understand how the service was proposed to be performed.

The developement of electrical machinery and appliances in general is such as to warrant the satisfactory working of the system that I am about to describe to you, viz.: — The state of perfection to which the accumulator or storage batteries has reached which I propose to employ for furnishing current to actuate the signal devices on the locomotives.

This system consists of two signaling devices placed in the cab of the locomotive, together with a recording device for recording the hour, minute and second at which the signals are given and cleared, and a trailing or contact device attached to any suitable or convenient part of the locomotive, such, for instance, as at the forward end of the frame or to one of the tender trucks, where it will be most out of the way. The signals in the cab are, as I said before, two in number; one is arranged to indicate a broken rail, misplaced switch or open drawbridge. The other is to indicate a moving train or a car on the section ahead. The first signal, we will call, the broken circuit signal. This signal device is held at "safety" by the action of the current constantly traversing the circuit while the locomotive is out of the round house, and the second signal is brought into "danger" by an increased current traversing the circuit. When the signal goes to "danger," it is audibly and visually indicated to the engineer, 1st, by striking a gong and lighting an incandescent lamp. The gongs in each signal are of a different sound and the lamps are provided with different colored glasses, so that by the sound of the gong the engineer can tell what character of obstruction he is approaching, the lamps indicating, during the time of said obstruction, its character. Thus, it will be seen that he has before him at all times the signals required for his guidance.

The track arrangements for operating this system are as follows: The tracks are divided up into any desired length, say from that of an eighth of a mile to that of even a mile or two, in straight sections of the road. We will take, for instance, a block of half a mile in length as an illustration, and say that we require a distance of a thousand feet before reaching said block as being necessary to enable the engineer to come to a full stop. In order to give notification to the engineer a thousand feet away what the condition of the track in that block is, I provide an extension or subsidiary rail, which is made of small angle iron and placed back parallel with the regular rails at any desired distance from them, and supported on suitable string pieces fastened to the cross-ties. The forward end of this thousand foot section is riveted to the rail of that section and becomes, as it were, a part of it. At the further end of this half mile section, the two rails of the track are connected together by what is known as a resistance coil which offers a constant resistance to the passage of the current. The rails are what is called bonded, namely, connected at each joint by suitable wires to iusure their electrical continuity.

Now, in order to explain the uses of this extention rail and resistance coil, we will consider that the locomotive has its signaling and recording devices together with a suitable battery for actuating the same and a trailing contact arrangement to engage with this extension or subsidiary

rail. The locomotive coming to the end of this rail, the contact engages with it, which sends the current down one rail, through the resistance coil at the end of the sections and back through the other rail to the wheels of the locomotive. This makes what is known as a metallic circuit for the current to flow over and, as I said before, holds the broken circuit signal at safety. Providing this section is clear and there is no break in the rails, there will be no danger signal displayed in the cab, but should the rails be broken, or a switch misplaced, it will be readily seen that there will be no circuit for the current to flow through and consequently signal device No. 1 would be released and instantly go to "danger," ring a gong, light an incandescent lamp and make a printed record of the time that such signal was given.

On the other hand, if there is a train in this block, whether it be moving or standing still, the wheels and axles of that train constitute a bridge, electrically speaking, between the two rails and cut-out from the circuit the resistance coil at the forward end of the section. The cutting out of this resistance from the circuit will cause an increased current, namely, one of greater amperage, to flow from the battery through the signaling devices which will actuate danger signal No. 2; the gong on which signal emitting a different sound from the other and having a lamp of a different color the engineer is instantly made acquainted with the fact that there is a train on the block ahead, one thousand feet before he reaches it. This enables him to stop his train before he reaches the end of that block and he waits until the train moves off.

The time recording device here comes into play again. As I said before, it makes a printed record of the hour, minute and second when the signal is given and another printed record when the section ahead is cleared. The time intervening between these two records will show the length of delay to the train, due to that obstruction.

I omitted to remark that carried on the locomotive, and so arranged as to be brought into circuit when the trailing contact is not engaged with the subsidiary rail, is a resistance coil equivalent, electrically speaking, to the entire resistance of the block including the resistance coil at the forward end. Therefore, we have at all times a closed circuit for the current to flow through, and where all sections of the track are clear and not broken by misplaced switches or open draws, no changes take place in either of the signal devices carried on the locomotive.

The arrangement of the tracks for the operation of this system is similar, with reference to the length of its block, to that of any of the present systems in use; namely, that the road is so divided, in accordance with the running of the trains, that there is always a block between the trains. Thus, close to large cities or business centers, the blocks would be very short, and as they progressed on the road they could be length-

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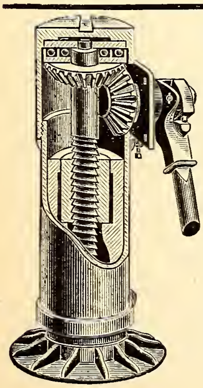

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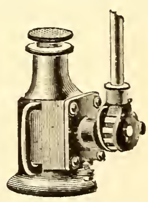

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ened out to any desired length, excepting on curves, where, I believe, they should again be shortened up to about a quarter of a mile in length or even less in some very bad places.

The subsidiary rail or extension I speak of here as being a thousand feet in length; of course, it will be readily understood by you, gentlemen, that the length of this extension will vary with the grade of the road, speed of trains, etc. On down grade, at very high rates of speed, these extensions would have to be in some cases two thousand feet, or even more, in length; while, on a corresponding track, going up grade, they need not be more than four or five hundred feet in length. Consequently, the average on a road would be about one thousand feet in length for each block.

I will now speak of the comparative cost in installation of a system of this character with those now in use. Admitting that with an automatic system, the rails proper require to be bonded throughout, the same would be true of this system; then we have, merely, the additional expense of these extensions or subsidiary rails with the resistance coils at the forward ends of the blocks to figure as the cost of rail of installation. Light angle iron being used, it is safe to say that the average cost of these extensions would not exceed, excepting in cases where there were numerous switches or cross-overs, over seventy-five dollars per block, and, in the majority of cases, a much less amount.

Now, there being no movable parts to the rail construction, no track instruments, air compressing devices or levers to be actuated by the wheels of the locomotive, the entire track arrangement can be taken care of by the ordinary section men, no skill whatever being required in the care of this part of the system. There being, as I said before, no wires to get out of order, the thing becomes, practically speaking, a part of the regular rail system of the road.

The locomotive arrangements are such that they require no attention on the part of the engineer; the movement of a small switch in the cab of the locomotive connects the battery with the signaling devices and the contact levers spoken of before, and throwing the switch off at the end of the run, opens the circuit of the battery, consequently there is no consumption of the current going on when it is not in use.

These batteries are charged in the round-houses of the locomotives and require no care on the engineer's part. The cost of charging the batteries being, practically speaking, the cost of operating the system. And when the railroad companies have their own electric lighting plant, the cost of charging them is indeed very small.

To roads that are not provided with their own plant, currents can be obtained from the electric light companies in those places for charging the batteries, at a very nominal price. It is safe to say that the cost, under any circumstances, would not exceed that of twelve and one-half

cents a day for each locomotive, and might in some cases be reduced to half this amount. Therefore, it will be seen that the system is not alone an inexpensive one to install but also an economical system from a maintenance standpoint.

You will see that by the use of a system of this kind, semaphores banjos, towers and other signaling devices along the roads are entirely dispensed with. The engineer's attention is not taken away from the locomotive ; his carrying his signals with him enables him at all times and under all conditions of the weather to see just what character of obstructions there are ahead, thus relieving him of the mental strain that he is now under when running under the present signal system provided. He never needs to question what kind of a signal was displayed before him, as is often the case at present, for the reason that he has them before his eye at all times.

I venture to say that the cost of oil, breakage of chimneys and care of lamps entailed in the use of the present systems would pay a very handsome return on the money invested in the installation of this system, over and above the cost of its operation.

I will here say that this system is equally as applicable to single track roads as it is to double track roads, and for a three or four track road has advantages over all other systems, in so far that no expensive structures such as are used to give the signals to the inward tracks are required, and said tracks, as you will readily see, can be divided into blocks of any desired length and character more inexpensively than with any of the present systems in use.

Now, gentlemen, I will conclude by saying that I believe in calling things by their true names ; and when we speak of an Automatic Railroad Signal System, let us understand that it is entirely automatic and not at all dependent upon human beings to actuate the devices. Let them be, as I said before, entirely automatic, directly under the control of the engineer and free from any wire connections or other delicate electrical devices, whether in the form of track instruments, semaphores or signal appliances placed alongside of the track.

The persons for whose guidance all signal devices are employed are the locomotive engineers, therefore, they should be placed where they belong, in the cab of the locomotive and nowhere else. And, as I make use of the rails over which the trains are run for the conductors and carry all current-producing devices for actuating the signals right on the locomotive, I feel justified in calling this an Automatic Signal System, pure and simple, and one that I believe will see recognition by the railroad managers of the country.

With your kind indulgence, I will mention the few features in connection with this system that I omitted to speak of before, viz. : that

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Frank W. Furry, *General Manager,*
1302 Monadnock Block, Chicago.

WORKS:
WADSWORTH, O.

signals of the approach of the train can be given at grade crossings, stations and other places desired, from the currents carried by the locomotive, by simply insulating the joints of the rails apart at such places and leading wires to gongs or even electric lights, which are either rung or lighted by the approaching train, to give warning of its coming. At turn-outs and switches, lights or semaphores can also be displayed which will give notice to those making up trains of the approach of the trains on those sections.

Again, with this system, there need be no fear of what are known as "tail-end collisions." The fact of the train being on the track blocks the train approaching, and there is no necessity for sending flag-men back to flag the approaching train, excepting in cases of emergency where two trains are allowed to enter the same block in order to clear a siding or the entrance to a branch of the road.

I believe the simplicity and inexpensiveness of this system will commend itself to all practical railroad men, as being what I claim for it, a simple and efficient automatic railroad signal device.

And now, Mr. President and Gentlemen, thanking you for your very kind attention, I will close.

The President. The next is a paper by Mr. J. P. Coleman, which Mr. J. T. Chamberlain will read.

PNEUMATIC INTERLOCKING.

PAPER BY J. P. COLEMAN. READ BY J. T. CHAMBERLAIN.

Work on Pneumatic Interlocking at the Boston & Maine R. R. Terminal, was begun about June 1, 1893, and was carried toward completion with the headhouse and trainshed, as rapidly as the laying of the new tracks would permit.

On March 18, 1894, at Prison Point (crossing of the B. & M. R. R. and the F. R. R.) the machine governing this crossing was put into service, and the delay and inconvenience due to the "know-nothing" stops that were formerly required by law were avoided, and a decided gain in time all around effected.

Owing to the renewal of the Charles River draw-bridges, and much new timber work throughout the track system — located entirely upon piles — the interlocking at the terminal station was not put into actual service until June 17, 1894 (Bunker Hill Day) ; and though considerable inconvenience was experienced on that day by both passengers and trainmen, owing to the new system's initiation, and the extra trains due to the holiday, the next day found a great improvement all around ; and by the third day, the perfect operation of the apparatus and the complete co-operation of the employees involved brought the traffic down

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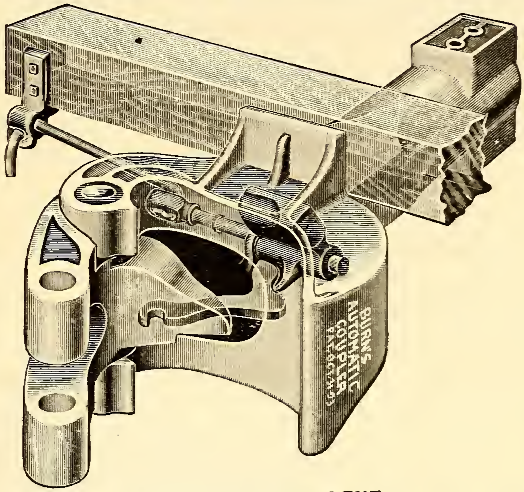

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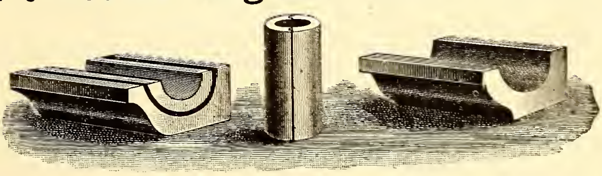

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to schedule time, which was an unusually creditable showing owing to the very large number of trains handled, and to the fact that the system of operating the train-shed was a matter of experiment for several days, it having been the original intention in designing the terminal to use the western side of the station for inward and the eastern side for outward trains entirely.

Two days trial of this method demonstrated it to be impracticable, for a time at least, and the method of operating the shed on the division principle was adopted, *i. e.:*

Tracks 1 to 5 were assigned the Eastern Division, tracks 6 to 9 the Western Division, tracks 10 to 15 the Fitchburg R. R. (which as yet occupied its old station) and the balance of the tracks from 16 to 23, were given up to the Southern Division. This plan proved feasible and is the system employed today.

Some uncertainty, however, existed as to the facilities afforded for handling the Fitchburg when it was about to enter, and an additional set of six cross-overs were introduced into the track system to obviate any possible inconvenience; this and a few minor changes delayed the entrance of the Fitchburg until August 12th, on which day the one hundred and ten additional trains were cared for without more than five minutes delay to any, the majority being practically on time.

Since that time the entire system has worked with marvellous smoothness, and the enormous traffic of five hundred and fifty-eight regular trains in less than eighteen hours of each day are cared for with as little apparent effort as though the matter of time did not enter into consideration.

From the table below, will be seen the number of trains arriving and departing from the station, from 5 a. m. until 12 p. m., during each hour of the eighteen that constitute a day of passenger traffic at the terminal.

OUT BOUND.		IN BOUND.	
TIME.	NO. OF TRAINS.	TIME.	NO. OF TRAINS.
A. M.		A. M.	
5 to 6	0	5 to 6	3
6 to 7	12	6 to 7	16
7 to 8	16	7 to 8	26
8 to 9	17	8 to 9	37
9 to 10	14	9 to 10	20
10 to 11	13	10 to 11	17
11 to 12	10	11 to 12	11

OUT BOUND.		IN BOUND.	
TIME.	NO. OF TRAINS.	TIME.	NO. OF TRAINS.
P. M.		P. M.	
12 to 1	13	12 to 1	12
1 to 2	15	1 to 2	14
2 to 3	13	2 to 3	10
3 to 4	19	3 to 4	12
4 to 5	20	4 to 5	14
5 to 6	39	5 to 6	18
6 to 7	30	6 to 7	16
7 to 8	15	7 to 8	20
8 to 9	4	8 to 9	9
9 to 10	9	9 to 10	10
10 to 11	8	10 to 11	10
11 to 12	12	11 to 12	4
TOTAL,	279	TOTAL,	279

Fourteen different times during each day, there are four trains scheduled to leave the stations at the same instant, and during the hours from 5.40 a.m. till 6.40 a.m. there are fifty-nine trains that arrive and depart, or practically one a minute for an hour.

On an average, each train entering or leaving the station involves four movements through the system. 1st, the empty train is backed into the shed from the yard by a shifting engine. 2nd, this shifter is returned to the yard, or other convenient point. 3rd, the road engine backs from the round-house in against the train, usually about five minutes before its departure. 4th, the train starts on its regular run. This for outward trains.

For inward trains the routine is as follows: 1st, the train runs into the station and discharges it passengers. 2nd, a shifting engine backs in against it to take the empty cars to the yard to be cleaned and inspected. 3rd, the shifter and empty train are signaled out into the yard. 4th, the road engine is then signaled to the round-house, turntable, water plug, or coaling station, as occasion demands.

It will be seen by this that a train every minute involves a move every fifteen seconds, and it will be equally apparent that a man who directs these movements must not only be on the alert at all times, but must also be a man of no small supply of self-possession, as the slightest oversight on his part might produce conditions that would result in the late arrival and departure of all trains for the balance of the day, if not a total blocade of the terminal.

That this is not of frequent occurrence seems to the visitor in the

tower, from which all traffic is directed, almost a miracle, and the absence of confusion and general demoralization among the men that are entrusted with the thousands of lives that are daily carried in and out of this railroad bee-hive gives one of the most forcible examples possible of the triumph of mind over matter.

Located in this tower, are six men on regular duty, of eight hours each. Two directors, two levermen, a telephone man, and a telegraph operator.

The director is responsible for all movements made, and all movements are made under his instructions to the levermen. The levermen simply execute the orders of the directors, by manipulating such switch and signal levers as are necessary, to provide the necessary track connections and signals for the desired movement on the ground.

Information to the directors is conveyed from the various yards, including the train-starters, yard and station-masters offices, by telephone, telegraph, and specially designed electrically operated indicators and annunciators located in front or near the side of him, and are presided over by the aforementioned telephone man and telegraph operator.

Among the special features of interest in this annunciator system are these: — Each of the twenty-three tracks in the shed form an independent rail circuit, which acts upon a miniature signal in the front of the train director in the tower, in such a way that when the track is occupied by a train, the signal stands in the clear position, but when the track is covered by a train of any length the miniature signal stands at danger, this affording means during night or foggy weather of ascertaining which tracks are in condition to receive trains and which are not.

Combined in this same instrument is a second system of indicators, of a slightly different pattern, which are operated by the train-starter in the depot, and which are normally invisible. When a train is about ready to depart this train-starter operates a button in his office, which corresponds in number to the track from which the train is to leave, and thereby displays that one of the indicators in the tower which also corresponds to that track, at the same time giving a tap upon a bell to call attention.

This he does not do, however, unless personally advised by telephone, that the cars have been inspected, charged with air for the brakes, and gas for the lights, and that the train's crew is ready.

This train-starter is located in the centre of the inner end of the shed near the roof, and has a good view of the interior of the shed from his little box-like perch, and is connected by telephone with the inner and outer ends of the shed, between each pair of tracks, so that he is kept constantly advised of the situation in the shed at all times. Any car found defective, for instance, will be reported to him, and he will advise

the tower, and they in turn will have it removed by a shifter and another one substituted. Delays due to this, and other less important happenings, are reported to him, and the tower is thus constantly advised through him of any delay that may be expected from the trains in starting.

Before entering into a further description of the system, a few remarks concerning its peculiar features will not go amiss.

Air compressed to eighty pounds per inch is the motive power by which the signals and heavy steel rails of the switches and their accompanying attachments are operated, and electricity is the agency by which this pressure is so controlled as to give prompt action to the switch and signal mechanism, at any desired distance from the interlocking machine located in the tower.

The air is supplied by one of two 14 x 18 Ingersoll-Sargent compressors of the latest design, located in the terminal power-house; a third compressor for emergencies being in reserve in a power-house at the extreme end of the system at Prison Point.

The air on leaving the compressors passes through a system of manifold pipes of very great surface area, located on the side of the power house, for the purpose of bringing it down to atmospheric temperature and there by condensing the moisture in it (which is drained into a suitable tank and discharged at regular intervals) before it passes into the main supply pipe of the system.

This air main is of three-inch galvanized steel pipe, and runs from the power-house at the terminal to the one at Prison Point, a distance of six thousand feet, passing in duplicate under the Charles and Miller's River draws. At each switch and signal operated, it is connected by a three-quarter inch branch pipe with a small reservoir for the collection of sediment or moisture that may be contained in the main, and preventing their access to the more delicate parts of the operating mechanism.

Attachments have been made to the engines of five drawbridges from this main for the purpose of avoiding the attention and expense of maintaining the pressure in five steam boilers now used for this purpose.

A large duplex Blake pump is also attacked to this air main, and stands constantly ready to throw a two-inch stream of salt water from the Charles river over any fire that might develope in the vicinity of the tower and draw bridge structures.

Another purpose to which this compressed air is put is in charging the brake cylinder reservoirs of trains about to leave the shed, thus avoiding the delays often resulting from the time required by the ordinary locomotive brake pump to do this work when the locomotive is late in getting to its train.

Its still further use is contemplated in operating sand conveyors and coal tipples, turn-tables, etc., to which purpose it is especially adaptable.

The electricity used in controlling the valves of the switch and signal device, is derived from two sets of storage batteries of the Sorley type, made by the Eastern Electric Light & Storage Battery Co., of Lowell, Mass. They consist of twelve cells each, of three hundred ampere hour capacity, and are charged in series during the day by one of the large Westinghouse incandescent dynamos of the terminal power plant, which during this time is kept running to supply a few lights in the station in dark places at an otherwise loss of energy.

From these batteries a heavy supply wire is connected to the electrical combination of the interlocking apparatus, which is of such a construction that the movements of its many small levers, by the manipulator in the tower, causes the current to flow or to discontinue to flow in some of the five hundred wires which lead therefrom and connect to the many switch and signal mechanisms of the system, the effect of which is to act upon their electro-magnetic air valves in such a manner as to produce the desired operations of the switches and signals.

These wires are, for convenience, in the form of five conductor cables, and for the terminal plant alone aggregated in length 325,000 feet of single wire, or about sixty miles.

As the Charles River practically cuts in two the system of tracks, submarine cables are used under this river to control the switches and signals on the depot side; these comprise six sixty-one conductor cables, placed in three-inch galvanized iron pipe, and three nineteen conductor cables of the usual iron wire armoring, making a total of four hundred and twenty-three wires under the river.

In applying the large cables the pipes were first put in position three feet below the bottom and thirty-five feet below high tide, and the cables then pulled through, especially long socket couplings being used on the pipes to guard against the accidental breaking at the threaded joint.

It is now understood that to each signal and switch mechanism there runs a connection from the air main and one or more wires from the interlocking device in the tower, it yet remains to show how the elements thus conducted are controlled.

The switch mechanism consists chiefly of sliding bar which is attached to the piston of an air cylinder and made to engage a peculiarly shaped bell crank connected to the switch rails; the extreme end of this bar being connected by a horizontal lever to one or more detector bars located ahead or to the sides of the switch, which are mounted on the upper ends of a system of radial links pivoted at the rail base in such a manner that a longitudinal movement of the bar is immediately accompanied by an elevation of the bar above the level of the rail and

a final receding of the bar to its former level when the bar has completed its longitudinal movement.

If a pair of wheels rests upon this bar it is evident that it cannot be raised and consequently cannot be moved lengthwise; therefore, during the presence of a train upon a switch, the movement operating the switch cannot be moved, it being connected directly with the detector bar as previously stated.

The bell crank operating the switch is not moved by the slide bar of the movement until the latter has moved a short distance, which movement withdraws a lock bolt from a hole in a bar secured to the switch points, thus making its movement possible; likewise its movement ceases before that of the slide bar, the final movement of the bar being utilized to again lock the switch in its reversed position by a second lock bolt also mounted on the slide bar.

It is evident, then, that a complete movement of the bar itself must preceed a complete movement of the switch at each operation, and that the complete movement of the slide bar insures the locking of the switch points in their proper positions; this is of the greatest importance, as upon it depends another feature of the system which is peculiar to it.

Mounted directly over the slide bar is a box-like casting containing a circuit shifting device that is operated by the bar only after the lock bolt has entered the switch rod and locked it; this device is connected electrically with a similar device and an electro-magnet attached to the switch lever of the interlocking machine, and is used to electrically release the lever after the switch has responded to a previous partial movement of it, whereupon its complete movement may be made, and the proper signals thereby released.

The signal mechanism consists of a three-inch cylinder mounted vertically upon the post in a suitable casing, and is provided with a valve chamber, and an electro-magnet controlling the valve thereof in its upper chamber, and a piston which is joined by a link to one end of the counter-weighted lever, the other end of which is joined to the signal.

When the magnet becomes charged by an electric current from the operating machine, it operates the valve so as to admit the air to the cylinder, which depresses the piston and elevates the weighted end of the lever and the signal rod, thus lowering the signal to the safety position.

When the electric current is cut off the magnet releases the valve, and the air in the cylinder thereupon escapes, and the weighted parts of the signal restore it to the danger position.

There are at the terminal station side of the Charles River draw seventy-two signals and thirty-six single switches, eighteen double slip switches and four movable point crossing frogs; and on the tower side of

the river, forty-three signals, eleven single switches, twenty-six double slip switches and thirteen movable point crossing frogs; or a total of one hundred and seventeen signals, forty-seven single switches, forty-four double slip switches, and seventeen movable frogs, besides the necessary detector bars, which aggregate in length 8,910 feet, all operated from the one machine in the tower.

At Prison Point a similar machine of about three-fourths the size of the one at the terminal handles the net work of switches and the many signals governing the traffic at this point, which involves the Junction and crossing tracks of the Fitchburg with the Boston & Maine R. R.

The Secretary then read a communication from Mr. W. L. Derr, Superintendent of the New York, Lake Erie and Western Railroad Co., as follows:

PORT JERVIS, N. Y., May 4, 1895.

NEW ENGLAND RAILROAD CLUB, Boston, Mass.

Gentlemen: I am very sorry that I am unable to be on hand to hear and take part in the discussion of "Electrical Apparatus in connection with Signaling and Moving of Trains," as many good points will undoubtedly be brought out by the members.

I am glad the Club has taken up this subject, which is one that all engaged in railroad operation should be familiar with, and, of necessity, will have to know much about in the near future.

When we stop to consider that a most excellent block system can be installed by merely supplementing the ordinary train order signals with electric bells, placed in the telegraph offices at traffic stations and connected by an electric wire, so that by a prearranged code of signals prompt communication may be had from one station to another, one is prone to wonder why more railways do not adopt the block system. Of course, there are other and more expensive block instruments, which may be used to advantage, but with the train order signals and electric bells, a good system of blocking may be had.

Following is the bell code of the Erie road:

1 Acknowledgement of any signal except as herein provided.

2 All right? Yes.

3 { Unlock my lever (Sykes system). Answer by plunge, 5 or 3–1.
Is block clear? Answer by 2 or 5. }

4 Train has entered block.

5 Block not clear. Or, block obstructed.

6 Is there a train coming to me?

2 1 No.

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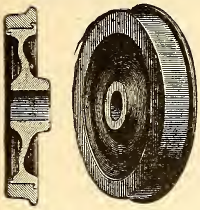

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2–4 Has train cleared? Answer by 4–2 or 5.

3–1 Have plunged (Sykes system). If you are not unlocked, allow train to proceed under green. Repeat 3–1 to sender.

3–3 Train is on siding clear of main track. Allow train to come in block under clear signal.

3–3–3 Train to you broken in two. Answer by repeating 3–3–3 to sender.

2–3–2 Signal just received not understood. Please repeat.

4–2 Train has cleared.

4–4 Train is going on side track.

2–2–2 Error signal. Repeat to sender.

6–4 Testing signal. Repeat to sender.

9 Stop train. Has no markers.

3–2 Train from you passed without markers.

5–5 Train has crossed over onto opposite track. Repeat to sender.

2–5 Stop and examine train.

3–5 Train is returning to its own track.

4–1 Train has left preceding passing track (to be used only on single track.)

To illustrate: There are two adjacent block stations, A and B, and there is a train at A going to B. Before permitting the train to pass A the signalman there asks B by bell code "Is block clear?" (3 strokes of the bell). If the block between A and B is clear the signalman at B answers "Yes" (2 strokes). A then permits the train to go forward. When the head end of the train enters the block, A gives B the bell signal "Train has entered block" (4 strokes), which B acknowledges by giving A one stroke of bell. When the rear end of the train (with train markers) passes B the bell signal "Train has cleared" (6 strokes given thus: four strokes, pause, 2 strokes) is given to A. Had the block not been clear when A asked B "Is block clear?" B would have answered "Block not clear" (5 strokes) and A would have held the train until B had said it was clear.

The above bell code is wholly empirical, and may be varied to suit convenience and local conditions.

I hope that some of the members will call more than passing notice to the Webb & Thompson electric train staff machine, and the Tyer train tablet machine, both of which are designed to carry out the absolute block principal on single track lines. On double track, as is well known to all, the function of the block system is to prevent trains from overtaking each other between stations. On single track this has to be done, with the all-important addition that the movements of trains toward each other, that is, head-to-head movements, must be governed; and it was largely with the view to absolute safety in the

movement of trains running on a single track in opposite directions that the train staff and tablet machines were devised.

One of these machines is placed at each end of the block and connected with the machine at the other end by an electric circuit. It is operated mechanically, but unlocked electrically.

The Webb & Thompson machine is about five feet high, and in general appearance resembles the "nickel-in-the-slot" weighing machines often seen around railway passenger stations. In the column of the machine is placed a number of hollow metal staffs, which are about the size of a policeman's baton. When one of these staffs is removed another cannot be taken from the same machine, nor from the machine at the other end of the block, until the staff is replaced in the machine from which it was taken or in the machine at the other end of the block; hence, when a staff is given to the engineman of a train there is no way of obtaining a staff for another train until the first is replaced in either of the machines. It will readily be seen how completely the giving out of a staff locks up the block, when it is considered that a train in the block has the only key by which the machines at either end of the block can be unlocked so that a staff can be taken out for a train in the opposite direction or for a following train. It is manifestly impossible for that key to be delivered up until the train arrives at the block station in advance.

The Tyer machine works on the same principle as the Webb & Thompson, a round tablet or metal disc being used instead of a staff.

An unfailing electric track circuit is now called for in the more advanced systems of blocking, such as the controlled manual, in which the signalman at the advance end of the block controls, through electric agency, the signals at the rear end of the block; and the automatic system, in which the signals are operated electrically by the passage of a train into and out of the block. Much of the trouble with the rail circuit is from grounding when the rail is in contact with certain kinds of ballast, and from imperfect work done by trackmen in making track repairs. Any suggestions for the betterment of the track circuit will be a boon to those who have these circuits to care for.

The writer has used, successfully, electric light for night signals, green as well as white. Where a green ("caution") signal has to be displayed at intervals the electric light will be found valuable, as, with the aid of an ordinary key circuit breaker, the light can be displayed or cut out at will.

Respectfully,

W. L. DERR,

Supt. N. Y., L. E. & W. R. R. Co.,

Delaware Div.

The PRESIDENT. This closes the reading of papers on this subject from different parties, and there is now an opportunity for any one of the Club present or visiting parties to present anything they have to say on this subject.

Mr. ADAMS. Mr. President, I would move "That the thanks of the Club be extended to the gentlemen who have presented papers to be read here to-night, and also to the gentlemen who have read them."

The motion was seconded and adopted.

Mr. CHAMBERLAIN. Mr. President, I would move "A vote of thanks to Mr. Willis for his paper on the death of Mr. Charles Richardson."

The motion was seconded and adopted.

No discussion following the reading of the papers, the meeting was then adjourned, 9.50. Eighty-eight members present.

NEW MEMBERS.

Barnes, C. H., Div. M. M., B. & A. R.R., Boston, Mass.
Carey, Thos. F., 315 Exchange Building, Boston, Mass.
Deane, John M., Foreman B. & A. Shops, Boston, Mass.
Gilman, John H., B. & M. R.R., Lawrence, Mass.
Martin, F. J., 22 Robinson St., Somerville, Mass.
Polk, W. A., 922 Havemeyer Building, New York.
Zelinder, C. H., Car Builder, Berwick, Pa.

CHANGE OF ADDRESS.

Bunker, Geo. C., No. Plymouth, Mass.
Gilbert, E. A., Ogden, Utah.
Tingley, Geo. S., 26 So. Union St., Pawtucket, R. I.

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New England Railroad Club.

AIR BRAKE EQUIPMENT

AND ITS

APPLICATION TO ROLLING STOCK.

PAPERS BY

R. A. PARKE, E. G. DESOE, AND B. J. GRAHAM.

Meeting of Nov. 12th, 1895.

Published by the Club,
EDWARD L. JANES, SECRETARY, P. O. BOX 1158, BOSTON.

Next Meeting, Tuesday Evening, December 10th, 1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, November 12, 1895.

Meeting was called to order at 8.00 o'clock P.M. by President BUTLER, in the chair.

The minutes of the meeting of October 9th were approved.

The PRESIDENT. Are there any committees to report?

Mr. CHAMBERLAIN. Regarding the Committee on Rules of Interchange meeting to be held at Pittsburg, I will say that the Committee have had two sessions, and they have formulated a report which is now on the way to Pittsburg, and the Committee expect to be there to transact the business for which they have been appointed.

The PRESIDENT. The subject announced for this meeting to-night is "Air Brake Equipment, and Its Application to Rolling Stock." We have with us Mr. R. A. Parke, of the Westinghouse Company, who will present a paper on this subject.

AIR BRAKE EQUIPMENT, AND ITS APPLICATION TO ROLLING STOCK.

By R. A. PARKE.

The subject upon which the writer has been invited to present a paper at this meeting is one of extensive breadth, and may include all the various forms of air brake apparatus now in use and a very considerable variety of special kinds of application. It is assumed, however, that no such extensive and unnecessary scope of the subject is expected to be discussed, but rather that a general consideration of the subject, as it more particularly applies to present railroad practice, is what is desired.

Nearly all of the air brake apparatus in use and most of the features of its application have been so often and so thoroughly discussed, that it would be uninteresting and wearying to you to hear these matters again rehearsed. Only the more recent modifications and improvements in the air brake apparatus and a very general consideration of the question of application will therefore be presented in this paper.

It will, perhaps, not be untimely, and not without interest, to briefly review the expanding usefulness of the quick-action air brake and its influence upon the development of modern railroad practice. It is nine years since interest in the dawning necessity of power brakes for freight service culminated in a series of brake trials upon freight trains. Almost in a day, the old automatic air brake, which had for years been satisfactory and had been adopted almost exclusively for passenger service, was, together with all its competitors, condemned as unsuitable for freight service, and its usefulness was thenceforth restricted to short passenger trains. At the termination of those brake trials, it was the almost universal conclusion that an electro-pneumatic brake would prove to be the only solution of the requirements of the times; but, within a year, and with modifications of such simplicity as no one believed possible, the old air brake was transformed into the quick-action air brake, which stopped long trains in about half the distance required by any of the older forms of power brakes and completely fulfilled all the prescribed requirements of a freight train brake. This consummation marked the beginning of a new era in American railroading. The freight train brake problem was solved, and its practical importance received such prompt recognition that one-third of all the freight cars in active service in this country have already been equipped with the air brake. There is now a number of railroads that require every freight train to be under the exclusive control of the air brake. Some roads have, in consequence, reduced the number of brakemen to two upon all through freight trains, regardless of their length, and in that way alone have effected an annual reduction in their operating expenses which covers all cost of operation and maintenance of the brakes and leaves a surplus of about seven per cent of the total sum expended in equipping their freight cars with air brakes. Upon some railroads, where practically all freight trains are controlled by the air brake, the average freight train speed has been increased twenty-five per cent or more, so that a considerably reduced number of locomotives and cars and only about four-fifths the former number of train crews are required to handle a given volume of traffic. The capacity for safely handling a larger volume of traffic upon the same number of tracks has also increased almost proportionally with the increased speed, and fully so where block signals are used. The number and cost of accidents upon railroads operating

all freight trains by the air brake have been very materially reduced, this reduction being known, in some cases, to amount to as much as fifty per cent or more. In addition, the cost of wheel renewals has been much reduced. The application of a moderate and uniform brake shoe pressure upon a large number of wheels, instead of a high pressure upon a few wheels, has resulted in the removal of a smaller number of wheels on account of flat spots from sliding, and has avoided the high temperature of wheel treads which causes cracked plates.

It has been predicted for years that all these economies would attend the general use of air brakes in freight service; today they are realized facts in even a greater degree than the foregoing statements would indicate. It may now with distinct modesty be asserted that, by subjecting all freight trains to full control by the air brake, the net earnings of a railroad may be annually increased to the extent of from twenty to forty per cent of the cost of applying the brakes.

In addition to its usefulness in freight service, the quick-action brake has, directly and indirectly, revolutionized the brake efficiency upon passenger trains. It has, on the one hand, materially reduced the distance in which heavy passenger trains may be stopped and, on the other hand, it has been the means both of forcing engineers to abandon many improper and dangerous practices, which had grown to be habitual, and of establishing a complete reform in the character of the brake gear. It had formerly been customary to use rods, levers, pins, and brake beams which would hold together under the application of the brakes and little more. If it was found that a brake rod broke too frequently in service, a rod of the next larger size of iron was substituted in service until the increased braking power required by some new and heavier style of car was found to rupture that size also, when the next larger size of iron was substituted. When the quick-action air brake was first introduced upon passenger cars, one of the most frequent complaints was that it tore the brake gear to pieces. No one had hitherto fully realized the weakness and inadequacy of the brake gear in use, and it was not until it went to pieces under the energetic performance of the quick-action brake that a thorough investigation and complete reconstruction was inaugurated. Many car builders and railroad officers looked aghast at the proposed increase in the size and weight of parts of the brake gear which was found necessary for efficient service; but the recognized importance of effective brakes caused the improved design to be accepted, and now practically all railroads have adopted it.

Investigation of the general character of passenger brake gear also brought to light a far too general neglect to properly take up the slack

in the brake gear, resulting from wear of the brake shoes, and to otherwise maintain the brake apparatus in effective condition. The efficiency of the air brake was, in many cases, completely destroyed through carelessness and neglect in these respects, and accidents were frequently found to have no other cause. The reform which has followed an exposition of the dangers of such neglect, and a persistent and diligent effort to instruct all trainmen and inspectors, so that the air brake shall be intelligently operated and maintained, has effected a most gratifying improvement in the efficiency of the air brake service. Today the average stopping efficiency of the brakes upon passenger trains is far more than double what it was seven years ago, and the great advance in shortening the time of passenger service during the interval has only been rendered possible, with due consideration for safety, by this increased ability to stop trains quickly in emergencies.

The remarkably fast time which has become an established element in practical passenger service within the past three or four years has, however, developed a demand for even a better stopping efficiency than that assured by the ordinary quick-action brake, and this requirement has instigated a modification of the quick-action brake apparatus which decreases the length of stops from high speeds about twenty-five per cent. As no description of this modification has been published, and as its importance to the safety of fast trains is becoming liberally recognized, a brief sketch of the features peculiar to the apparatus will be given, before a general review of present air brake practice is undertaken.

It has long been known that, while practically the same frictional resistance to the rotation of the wheels is required at all speeds to induce them to slide upon a dry rail, the same brake shoe pressure produces much more friction at low speeds than at high speeds. It has therefore been customary to so limit the maximum brake-shoe pressure that the friction developed at low speed shall not be sufficient to cause injurious wheel sliding. The total friction at any instant is the direct measure of the resistance which is then retarding the motion of the train, and a uniform brake shoe pressure therefore offers much less resistance to the motion of the train at the high speed in the beginning of a stop than at the low speed toward the end. It is evident that a much greater brake shoe pressure could be employed at high speed than at low speed without sliding the wheels, and this is the purpose of the modification of the quick-action brake which is now known as the "high speed" brake.

The high speed brake is, essentially, a quick-action air brake operating under a high air pressure. In emergency applications, it creates at first a high brake cylinder pressure which is gradually and automatically

reduced to sixty pounds while the speed is being reduced, and in service applications it limits the cylinder pressure to sixty pounds. These results are effected by the use of an automatic relief-valve which is attached to each brake cylinder, and consists of a piston, a slide valve and an adjustable spring. The spring is so adjusted that the valve is inoperative when the air pressure in the brake cylinder is sixty pounds or less. If, after the cylinder pressure has reached sixty pounds, the supply of air to the cylinder continues, but with no greater rapidity than occurs in any service application of the brakes, a large port in the relief-valve is opened and permits the excess supply of air to freely discharge from the brake cylinder to the atmosphere, so that no increased cylinder pressure occurs. In an emergency application of the brakes, however, the air is supplied to the brake cylinder so rapidly and in so much greater volume that the pressure rapidly rises above sixty pounds and causes a longer travel of the relief-valve piston, whereby the large port of the relief-valve merely opens and instantly closes again, and the air is caused to escape from the cylinder to the atmosphere through a more restricted port, until the pressure has been thus reduced nearly to sixty pounds. When the pressure becomes reduced to sixty pounds, the further escape of air is cut off and that pressure is retained in the brake cylinder until the brakes are released from the locomotive.

As locomotives which haul high speed trains are generally also used in other kinds of service, it may be frequently necessary to change from the standard train pipe pressure of seventy pounds to the high pressure and *vice versa*. In order that this change may be quickly effected, the feed-valve attachment of the engineer's brake-valve is removed and replaced by a flanged fitting, from which two small pipes lead to a bracket under the running board. This bracket supports two feed-valves, the one set at seventy pounds pressure and another set for the higher pressure, and contains a three-way cock by which either feed-valve may be used as required. The pump governor is also supplied with a siamese and two diaphragms, one set at ninety and the other at one hundred and twenty pounds. The small air pipe leading from the main reservoir to the ninety pound diaphragm of the pump governor is supplied with a cock which is opened when a main reservoir pressure of ninety pounds is used, and closed when the higher pressure is required. Of course, if the locomotive is used exclusively to haul trains equipped with the high pressure relief-valves, the ordinary arrangement of the engineer's brake-valve and pump governor fulfils the requirements by merely adjusting them for the higher pressures. The train-pipe pressure used with the high speed brake is from one hundred to one hundred and ten pounds.

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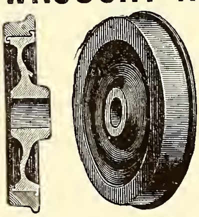

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Experimental tests of the high speed brake have demonstrated the importance of the use of sand on the rails in all emergency stops. Not only is a better stop made, but in case of a bad rail the use of sand is practically a necessity to prevent the wheels from sliding with the high cylinder-pressure employed. It is highly desirable that the application of sand should be automatic, so that the movement of the handle of the engineer's brake valve is all that will be required of the engineer in emergencies. The reasons for this are the same ones that condemned the use of a separate operative-valve for the driver brake, when it was formerly employed as an emergency appliance. It is therefore urgently recommended that, in all cases where the high speed brake apparatus is applied, a track sanding apparatus shall be used which will operate automatically in every emergency application of the brakes.

Beside shortening emergency stops about twenty-five per cent, another important advantage in the use of the high speed brake is the ability to make more than one effective application of the brakes without recharging. The importance of this feature in fast train service was well illustrated by an incident which occurred some months ago. A train equipped with the ordinary quick-action brake was running at the rate of about sixty-five miles per hour when the engineer observed a block signal set against him. He had hardly obtained a full service application of the brakes before the signal cleared and he released them. The speed had not been preceptibly reduced, but the air pressure in the auxiliary reservoirs had been reduced to fifty pounds, and, before it could be restored, the train rounded a curve just beyond the block signal tower, and the engineer encountered a drawbridge signal at danger. An emergency application of the brakes was promptly effected; but, when the train stopped, the locomotive was within ten feet of the open draw. That train is now equipped with the high speed brake, and it is found that, immediately after a full service application and release, there is still sufficient air pressure to make a considerably better emergency stop than could at any time be made with the ordinary quick-action brake.

Still another advantage of the high speed brake is the positive limitation of the brake cylinder pressure to sixty pounds in all service applications, regardless of the train-pipe pressure used. Although the brake leverage is such that a cylinder pressure of sixty pounds produces a ninety per cent braking power, and this braking power is available in full service applications, not a single pair of wheels is reported to have been removed from the Empire State Express trains on account of flat spots, during the two years that those trains have been equipped with the high speed brake apparatus.

An influential factor in the improved stopping efficiency under present air brake practice is the general use of brakes upon the driving wheels of locomotives. It is but a few years since a large majority of railroads either used no driver brakes at all or applied them for use as an emergency appliance only. It is the present practice of nearly every railroad in the country to make the driver brake just as much a part of the regular train brake equipment as the brakes upon the cars, and serious attention has been given to the fact that upon most engines something more than the driver brake is required to make an effective engine brake. The proportion of the weight of locomotives which is sustained by the drivers may be roughly stated as follows :—

For eight-wheel engines,	65	per cent.
For ten-wheel engines,	75	"
For mogul engines,	85	"
For consolidated engines,	90	"

The driver brakes of consolidation and mogul engines are generally very effective, because such a large portion of the total weight is utilized as a braking force. The driver brake of a ten-wheel engine acts upon only about seventy-five per cent of the total weight, and the eight-wheel engine, which is the one most used for fast trains, affords the driver brake much the poorest stopping power of all. The eight-wheel engine with driver brake only is in precisely the same position as was the twelve-wheel car a few years ago, when brakes were applied to only eight wheels; that is, it is supplied with but two-thirds the retarding power that it ought to have. The general reorganization of passenger brake gear, already mentioned, has happily included the application of brake shoes to the middle pair of wheels of six-wheel trucks, so that few twelve-wheel cars are now running without brakes for all wheels. The prejudice which formerly existed against the use of brakes upon wheels of the engine truck has been exploded, with the result that many of the engines used in fast passenger service are now equipped with brakes upon the leading truck. Just as it is today generally acknowledged to be a dangerous practice to operate passenger trains without locomotive driver brakes, it may safely be predicted that in a very short time it will be equally well recognized that a reasonable regard for safety requires the use of the engine truck brake. The promptness with which it has been applied to many of the engines of fast trains sufficiently indicates that it is already considered necessary to the safety of that class of passenger traffic.

Concerning the air brake equipment of passenger cars, there appears to be little to add to what has already been said. There is one feature, however, which deserves consideration. The ten-inch brake cylinder

was adopted for passenger car service at a time when it appeared that a cylinder of that size would meet the requirements of the heaviest eight-wheel passenger cars that were likely to be built. The weight of passenger cars has, however, steadily increased beyond those expectations, until it is now in many instances more than 60,000 pounds and in some cases more than 70,000 pounds. In order to apply a sufficient braking power to these heavy cars, it has been necessary to increase the brake leverage to such an extent that an excessive increase of piston travel accompanies a small wear of the brake shoes. In such cases, it does not require a great many applications of the brake to cause the total available piston travel to be exhausted, after which the pressure of the piston is wholly applied to the cylinder head and the effectiveness of the brake is destroyed. The use of metallic brake beams and stiff brake gear has reduced this difficulty in a considerable degree; but it is still often necessary, in order to prevent the entire disability of the brake before the end of a single trip, to take up the brake shoe slack so closely beforehand that the brake shoes drag upon the wheels while the brakes are released. Complaints from this cause have become so frequent, that it has become necessary to make some provision for larger brake cylinders upon heavy cars. In order to meet the requirements of the heaviest twelve-wheel cars, a brake apparatus which included a fourteen-inch cylinder was designed some years ago. Inasmuch as this size of brake cylinder is required for twelve-wheel cars, its use upon heavy eight-wheel cars has the advantage that no additional complication in brake apparatus is introduced, and no increased stock of repair parts is necessary. It is therefore now being applied to many of the heavy eight-wheel passenger cars. There are some objections to the use of so large a cylinder upon an eight-wheel car. Its capacity is double that of the ten-inch cylinder, and it is therefore larger than is necessary. It is also necessary to cut down the brake leverage in proportion to the increased power of the large cylinder. While this has the advantage of practically wearing out a set of brake shoes without taking up the slack, it also requires that the slack shall not be taken up so closely that too short a piston travel results, as this causes an unusually high cylinder pressure and wheel sliding may occur in consequence. There has been a demand in some quarters for a size of brake cylinder intermediate between the ten-inch and fourteen-inch sizes, and the design of a twelve-inch cylinder apparatus is now about completed. This will soon be on the market for those who prefer it to the fourteen-inch cylinder apparatus for heavy eight-wheel cars. There is no doubt that the ten-inch cylinder brake reaches the limit of its best usefulness upon cars weighing about 50,000 pounds, and heavier cars should be equipped with a brake cylinder of larger size.

In view of the many exhaustive discussions of the air brake equipment of freight cars during recent years, little can be said upon the subject that would be better than a repetition, and it hardly seems worth while to undertake any consideration of details. The substantial form of brake gear adopted by the Master Car Builders' Association has in general proved to be very satisfactory, and it is applied to practically all freight cars which are now being equipped with the air brake. The wooden brake-beam is fast becoming a relic of the inferior construction formerly employed for hand brakes, and metallic beams are rapidly replacing them upon old cars, as well as being applied almost exclusively to new cars. Brake gear so substantially constructed not only increases the effectiveness and value of the air brake, but will generally outlive the usefulness of the car, and is almost free of cost for repairs.

In applying air brakes to old freight cars, there are several incidental ways of reducing the cost, which usually make themselves manifest when the number of cars is considerable and the work is continuous. There is one simple and effective means of cheapening this work, however, which is worthy of careful consideration at the present time, when so many railroads are beginning an extensive and systematic application of air brakes and automatic couplers. The chief disadvantage under which the work of applying the air brake to freight cars is usually carried on, is the scanty room beneath the car in which to do the work. It is rare that the tracks used for car repairs are provided with pits, and the advantage of elevating one or more of the repair tracks for this purpose can therefore hardly be overestimated. It is an exceedingly simple matter to raise the track from two and one-half to three feet and thereby very greatly facilitate the application of the air brake apparatus and all changes in the brake gear. It has been satisfactorily done by placing twelve-inch timbers longitudinally beneath the rails and constructing a short inclined approach. The space between the timbers is free of obstruction, so that the men move freely about under the car and stand up at their work. The expense of elevating a piece of track of sufficient length to hold one or two days' supply of cars is nominal, and the timbers are practically uninjured for subsequent use in other ways.

While the question of the care of the freight brake is perhaps not properly included within the range of the subject assigned, its relation to the proper application of the brake apparatus and its general importance seem to justify a few words in its behalf. In the past, the chief obstruction to the control of freight trains by the air brake has been the difficulty of securing a sufficient number of air braked cars; one of the difficulties now frequently encountered is the inability to

make use of all the air brakes present in trains. It is not infrequently found necessary to cut a portion of the brakes out of service upon freight trains, because it is impossible to maintain the air pressure in all of them. This is in some cases due to the use of small air pumps upon the locomotive; and too much cannot be said of the importance of using air pumps of sufficient size to preserve the proper air pressure and to maintain a liberal margin of excess pressure in the main reservoir without too much labor. The small pumps were designed long ago for use upon comparatively short trains; wherever they have fallen into freight service they are rapidly being replaced by larger ones of sufficient capacity for long trains, and this feature of the trouble will soon be removed. An air pump of large capacity cannot, however, be expected to maintain the proper air pressure in apparatus which is so carelessly applied or maintained that a considerable portion of the air compressed escapes through leaky joints. The constant vibration of cars while in service requires that all air pipes and apparatus should be so firmly secured to the car body that no shaking or rattling of the parts is possible. Where insufficiently seasoned timbers or blocks are used, the shrinkage causes bolts to become loose and the air pipes to rattle. These defects should be promptly and fully remedied, or it will be found impossible to maintain a reasonably tight air apparatus upon such cars. Much more attention is now being given to these matters than formerly and the air brakes are better secured to freight cars, so that it may reasonably be expected that trouble from this source will be proportionally less in the future.

The most efficient service of the air brake upon freight trains will never be realized until proper facilities for inspection and repairs are provided. Inspectors are often not supplied with suitable tools to do the work, and brakes are frequently cut out of service upon cars because of leaks at pipe joints or unions, which could be quickly remedied if the proper tools were at hand. Inspection plants at inspection points are a practical necessity. A sufficient number of tracks at such points should be equipped with a supply of compressed air, so that all cars may readily be tested under the proper air pressure. Where such compressed air plants have been installed, the inspection of the air brake is systematic and thorough, while it occupies little more time and requires little, if any, more of an inspection force than where it is neglected. The use of separate tracks for inspection of air-braked cars also possesses the advantage that, when trains are made up, a sufficient number of air-braked cars may be removed together and placed at the head end of trains, without the trouble and delay of shifting; and, the number of air-braked cars being properly proportioned to the length of each train, all trains can in this way be con-

trolled by the air brake to the best advantage. The cost of the air compressing plant and the pipe and fittings for conducting the compressed air through the yard to the cars is insignificant in comparison with the advantages obtained, and the highly successful and economical operation of the freight brake upon roads which have introduced such plants is causing their introduction to be rapidly multiplied.

The foundation, upon which the whole superstructure of the brake system rests, is the frictional resistance to the rotation of the wheels that is caused by the forcible application of the brake shoes, and it would be a serious oversight to conclude this paper without a reference to the valuable information that is promised by the practical investigation of brake-shoe friction which is now being carried on. It has elsewhere been stated that some of the characteristics of brake-shoe friction have for some time been understood; but there is a great deal concerning brake-shoe friction that is not known, or is only imperfectly understood. It is indeed known that, under the same pressure, the same brake shoe produces different amounts of friction upon chilled cast iron and steel tired wheels. It has also been well recognized that brake shoes of different materials, and of different qualities of the same material, produce entirely different amounts of friction upon the same wheel under the same circumstances. Just how much difference there is in the friction-producing qualities of different shoes upon the same wheel, or of the same shoe upon different wheels, has never been satisfactorily determined, and the effective operation of brakes has suffered much in consequence. The report of the Master Car Builders' Committee on Brake Shoe Tests, which was presented to the Association last year, indicates that the friction-producing qualities of different kinds of brake shoes now in regular service vary to such an extent that satisfactory results can not possibly be expected from some of them if they operate under the same brake-shoe pressures that are required with others.

It is perhaps possible that it may prove desirable to use brake shoes of widely differing frictional qualities; but it is certain that no good results will be obtained from using such different shoes under the same conditions. A shoe which uniformly produces a small amount of friction must have a much higher pressure upon the wheel than a shoe which has superior frictional qualities; that is, the brake shoe pressure must be varied inversely with the friction-producing ability of the shoes. This would seem to be wholly impracticable, at least in freight service. Cars having the brake shoe pressure adjusted to the needs of a particular kind of brake shoe would inevitably be supplied with brake shoes of a different quality on foreign roads, which would necessarily result either in seriously impairing the efficiency of the brakes, or in the

danger of sliding wheels. Beside all this, shoes producing a low *average* friction do not produce a *uniformly* low friction, so that the pressure cannot be varied in the inverse ratio of the average friction produced by the shoes.

A reasonable perfection in the performance of power brakes seems to depend upon the ultimate selection of a standard metal for brake shoes. It may perhaps be very difficult to select any metal which shall be uniform in quality; but it is certain that a much nearer approach to uniformity can be reached in that way, than through the use of two or more different metals, or of widely different qualities of the same metal. It would appear to be, first of all, desirable to ascertain which metals produce the most uniform friction throughout a stop, and what brake shoe pressures must be used with these metals to produce the same amount of friction; this the committee is doing. The wearing qualities of these metals, when each is used with its required pressure, coupled with the wearing effect upon the wheel, would then seem to fairly indicate the value of each as a brake shoe metal. There are of course other incidental considerations; for example, it may be found that there is considerable collateral objection to any considerably increased strain upon the brake gear and parts of the trucks, in order to use a brake shoe metal of low friction producing capacity; also, it may be found that the increase or decrease of the pressure is not accompanied by a corresponding increase or decrease of friction, and the relative increase or decrease may vary with different brake shoe metals.

It would be idle to speculate upon the probable conclusion in regard to this question, and it would manifestly be unfair to the Brake Shoe Committee to attempt to do so. It is, however, to be earnestly hoped that the committee will receive the most liberal support, as further progress in the improvement of air brake apparatus will be seriously retarded until the enormous task which the committee has undertaken is completed. The development of the mechanical apparatus employed to produce the pressure of the brake shoes upon the wheels has already reached a stage of comparative perfection that seems almost absurd, in view of our ignorance of the actual service that it should properly perform.

The President. We will now listen to a paper by Mr. E. G. Desoe.

AIR BRAKE EQUIPMENT AND ITS APPLICATION TO RAILROADS.

There is no one thing that is of so much importance on a train to be controlled by Air Brakes as that of having open communication from

engine to rear air car through the train line. A brake may be cut out, or defective so that it is of no use, and the brake power of that car only is lost; but should the train line be closed, the brakes back of the stoppage are all lost, which may be all of them. A stoppage may occur by some foreign substance in the piping becoming lodged in the hose coupling or strainer, or in the winter by wet snow getting into the couplings, when brake is not in use, and freezing. The latter may be avoided by keeping the hose hung up in the dummy couplings, or coupled together. Water may come from the main reservoirs on the engine, and collecting in a low place freeze. Such cases of stoppage, however, are of very rare occurrence, and are caused by not draining main reservoirs daily, and blowing out the train line under tender before connecting to train. It is very good practice when two main reservoirs are used to connect them up so that all the air must pass through both; this will cause the air to be drained of nearly all its moisture before going to the train line.

While the above causes are liable to occur and cause a stoppage, the most common one we have is by the closed angle or stop-cock placed in the train line at either end of a car. This may occur by carelessness of not opening, or it may be closed by carelessness or some malicious person after opening, or by some object striking the handle; and lastly, but by no means an uncommon thing, on freight cars, work closed by the dead-wood or head block getting loose and bearing on the angle-cock key compress the key spring, and then, by working back and forth when train is moving, cause it to close. The train pipe becoming loose so as to vibrate and cause the key in an angle-cock to come in contact with the car will work it closed also.

If it were practical, it would be a great deal safer to do away with stop-cocks in the train line altogether; but it not being practical, especially on long trains, but by no means impossible, great care should be taken to place the stop-cock so that no part of the car getting loose will interfere with it, and fasten the train line firmly, also use a style of stop-cock that the handle is not likely to be struck and thereby closed.

I would recommend the placing of a conductor's valve, and air gauge, in freight cabooses, that the conductor may observe the train line pressure, and stop the train by the use of the valve before the pressure gets so low that it cannot be stopped by the air brakes, as might be the case if a stop-cock had worked closed, or some other stoppage occurred in the train line, and the air leaks off in rear part of train slow enough not to set the brakes. The use of a conductor's valve and gauge in a caboose is only available, of course, when all the train is equipped with air brakes.

Another thing of great importance when equipping freight cars with air brakes, and one hand wheel used (and I would recommend the use of only one), is to have it work with the hand brake; that is, when the air brake is applied, instead of its pulling the chain from the brake staff, it should push it up to it. This is of importance, because when equipped wrong it is dangerous for trainmen to use the hand brake; and if used in connection with the air it does not add to its power, and unless there is more power developed than what the air is furnishing, there is no increase of brake power. On the other hand, when equipped right there is no danger for the trainman, and when used in connection with the air adds to its power, and gives an increased brake power.

I think a freight car should be equipped so as to have a brake power of ninety per cent of its light weight, on account of there being so much difference in the weight of an empty and a loaded car. There are a great many cars in service, the light weight of which is 30,000 pounds, with capacity of 60,000 pounds; and with braking power seventy per cent of its light weight, obtainable only with sixty pounds pressure of air in brake cylinder. With seventy pounds train line and auxiliary pressure, to obtain sixty pounds in brake cylinder, the application must be a full emergency, and the piston travel not over eight inches. Assuming we obtained the sixty pounds pressure, we would then have a braking power of only about twenty-three per cent of the car's weight when loaded to its full capacity; should a service application be made, with eight inch piston travel fifty pounds is obtained in the brake cylinder; this would give with the car empty a braking power of about fifty-eight per cent, and when loaded of about nineteen per cent. If a partial service application of ten or more pounds reduction has been made when an emergency arises then nineteen per cent of loaded weight, and fifty-eight per cent of the light weight, is all the braking power that can be obtained. The reason of this is that after a service application of ten or more pounds reduction has been made, there is no perceptible gain from train line air entering the brake cylinder. This means a loss in braking power from what should be obtained by a full emergency application, on a car weighing 30,000 pounds, and braked at seventy per cent, of 3,600 pounds per car, or 180,000 pounds for a fifty-car train. Should the brake power be made ninety per cent of the light weight, then we would have on this same car, with a full emergency application, a braking power of thirty instead of twenty-three per cent of its loaded weight, a gain of seven per cent, which would be about 6,000 pounds per car, or 300,000 pounds on a fifty-car train.

As I have already said, I would recommend the placing of hand brake wheels at one end of the car only, and I think the brake power

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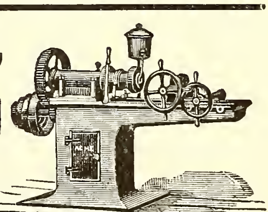

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obtained by it should be as high as seventy per cent of the light weight of the car; also, that it should be the same on both trucks. To obtain the same braking power on both trucks, it is necessary to have the power applied to the cylinder lever at the same point as the air power, for when applied as it generally is, to the extended end, there is from one to three thousand pounds difference in power applied to the trucks. The reason why this is thus, is on account of the floating cylinder lever being the same proportion as the cylinder lever without the extended end, which is necessary to obtain the same braking power on both trucks when the air power is used. The loss from this source, with that of the friction, causes the hand brake to be in many cases inefficient.

Some time ago I made some tests to ascertain the loss by friction when the hand brake was used, and found that on a car equipped with a single hand brake there was a loss of nine per cent between the brake staff and shoes; on a car with a double hand brake, one wheel, a loss of sixteen per cent, and on a car equipped with a double air brake and one hand wheel, connected through rod to extended cylinder lever, a loss of twenty per cent.

Thus it will be seen that our hand brakes, as usually arranged on freight cars equipped with air brakes, do not have the same brake power on each truck, as they should, and that there is quite a loss by friction. As some of you may say that with the air brake there is no need of so good a hand brake, I will say that in the short time we have been using the air brake I have known of several cases, on account of air pump out of order, broken train line pipe under tender, or insufficient brake power with the air brakes, that the hand brakes on the air cars were obliged to be used, either in connection with the air, or alone, to control the speed on a heavy descending grade. Such cases as these are where we need efficient hand brakes, and those that work with the air, so that a trainman will not hesitate to use them, as he surely will when he finds there is a chance of its yanking him off.

Another thing of importance in equipping a car with air brakes, and more so than many think, is the size of the brake cylinder; for any amount of brake power cannot be obtained by leverage with a limited piston travel. There is an old saying that a man with a lever long enough, and room to swing it in, can turn the world over. That fits our case exactly. If it were practical to have cylinders with unlimited piston travel, then we need to have but one size for all weights of cars, and obtain the desired brake power through leverage; but this not being practical, we must have different size cylinders for cars of certain weights. Recent discussions on the subject of piston travel, and the demand of a better air brake service, that a uniform travel be adopted

and maintained, has brought to light a great many cases in which the piston travel cannot be brought under nine or ten inches, on account of too small a cylinder being used. I have here a table taken from a Committee report on "Foundation Brakes," read at the "Second Annual Convention of Railroad Air Brakemen," held at St. Louis last April, in which the cars of various weights have been classified, and which shows the proper size of cylinder for each weight of car; also the total leverage, total piston travel, and brake shoe clearance had in each case.

TABLE.

FOR PASSENGER CARS.

Weight of Car.	Braking Force 90 per cent.	Cylinder. Diameter.	Cylinder. Stroke.	Cylinder. Pounds per Square Inch.	Cylinder. Value.	Leverage.	Total Piston Travel.	Adjustments to Wear Shoe 1 1-2 inches.	Shoe Clearance Brakes Off Requiring 4 inch Piston Travel.
		Ins.	Ins.				Ins.		Ins.
10,000	9,000	6	8	60	1,700	5.29	12.	2	·75
15,000	13,500	6	8	60	1,700	8.5	16.8	3	·32
16,000	14,400	8	12	60	3,000	4.8	11.16	2	.833
35,000	31,500	8	12	60	3,000	10.5	20.	4	·38
36,000	32,400	10	12	60	4,700	6.9	10.32	2	·58
49,000	44,100	10	12	60	4,700	9.38	18.	4	.426
50,000	45,000	12	12	60	6,800	6.61	14.	3	.6
70,000	63,000	12	12	60	6,800	9.26	17.82	4	·431
71,000	63,900	14	12	60	9,200	6.94	14.4	3	·576

FOR FREIGHT CARS.

	70 per cent.								
15,000	10,500	6	8	60	1,700	6.2	13.28	3	.645
16,000	11,200	8	12	60	3,000	3.73	9.6	1	1.00
50,000	35,000	8	12	60	3,000	11.8	21.2	5	·34

I will not read it, but it will be seen by it that passenger cars weighing 50,000 pounds or more should not use a ten-inch cylinder, and yet they are being put on cars weighing much more quite frequently of late, and trouble is experienced, where the proper braking power is given the car, in maintaining a low piston travel, and having the shoes clear the wheel, so as not to rub when brake is off. Especially is this difficulty experienced when wooden beams are used that deflect considerably.

A car weighing 60,000 pounds braked at ninety per cent would require the power of a ten-inch cylinder multiplied eleven and forty-nine hundredths times by leverage. This means that in order to obtain

one inch movement at the shoes we must have a piston travel of eleven and forty-nine hundredths inches, providing we have no lost motion. If we allow one-half inch clearance of the shoes from the wheels when brake is off (which is not any too much to prevent them from sometimes rubbing on account of not hanging true, and the beam springs taking more slack on one side than on the other), and the beams deflect three-sixteenth of an inch, our shortest piston travel will be, with the car standing, seven and eighty-nine hundredths inches, and this would give a travel of about nine and one-half inches when running, for it is generally allowed that a piston will travel from one to one and one-half inches more when running than when standing. It will readily be seen that cars which multiply the power through leverage as described must be watched carefully, and the slack frequently adjusted, or the piston will find the cylinder head. As eight inches is the piston travel which gives the pressure, at which the power of the cylinder is figured, then with a greater piston travel than eight inches we do not obtain the braking power intended; thus the reasons for multiplying the power of a cylinder by leverage, only a limited number of times, as shown by table.

It is my opinion that we have reached a stage where the use of air brakes on freight trains is a source of *danger* as well as safety. Any number of air brakes in use on a train makes it safer for that and other trains to run over the road, and should always be used; but a train partly equipped with air brakes may, by a sudden application of shoe brakes, cause a severe shock to the train, as is illustrated every few days in practice, which is liable to cause injury to a trainman and damage to freight and cars. This sudden application may be caused by breaking apart, bursting of a hose, poor judgment on the part of the engineer in using the brake, and lastly by defects in the brake which cause an emergency application when the engineer uses the service notch. Beside the liability of a partially equipped train causing damage, there is a continual expense to switch these cars to the head end of a train; and it seems to me it would be economy for the railroads to complete the equipping of their cars as quickly as possible, thereby stopping the expenses of switching such cars to the head end, and save damage caused by running partly equipped trains.

The President. Mr. B. J. Graham has a short paper which he will now read.

Mr. President and Gentlemen: — I wish to say a few words in reference to leaky check valves in the triple valve, and also to describe a device we have in use for testing car brakes, which may be found useful in the shop inspection.

The Westinghouse Co., in their Instruction Book, page 16, state, as is well known, that after the train pipe pressure raises the check valve in an emergency application of the brake, allowing the air contained there to add its force to that of the reservoir, the check closes, retaining the pressure accumulated and preventing its re-entering the train line. It is this last part, the check closing and preventing the pressure re-entering the train line, of which I wish to say a few words.

Through the construction of the valve in question, or rather its seat, it is unreasonable to expect it to remain tight for any great time. The seat being of cast iron rapidly corrodes and is pitted by the action of the moisture in the air, and it is of no rare occurrence to find the check firmly rusted to its seat so that a punch and hammer are required for their separation. Even if the valve is not entirely deprived of its motion, we find them with the wings imbedded in scale which, if the valve has any rotary motion when it is raised, will prevent its reseating itself properly.

It is well known that after an emergency application of the brake, it is of vital importance that this valve should be reasonably tight, since if it is not, the power which is needed to stop the train, and which in such an instance is supposed to perform that service in an unusually short time, is lost by leakage past the check, and the stoppage of the train would not be as satisfactory as if the quick action had not been used.

This seat being of iron and the valve of brass, it is an expensive and slow operation to grind them, since the grinding of the brass valve rapidly wears it, while the seat is scarcely worn any, thus necessitating the use of a reamer, or other special tools, to restore it, which tools are not always to be had handily.

I am pleased to say that the Westinghouse Co. have lately decided to bush these valve-casings with brass, which will prevent their rusting, be less expensive to repair, and will always perform more satifactory service.

In relation to the subject of testing car brakes, I wish to say a few words of a device for that purpose, which is in use and is giving satisfactory results. This device is substantially an engineer's valve in its operation, but is provided with hose couplings on short lengths of hose so that it can be readily coupled on to the air supply and to the car hose. Its parts consist of the hose and couplings mentioned, a supply pipe of the same area as the feed port of the triple valve (which supply is controlled by a thumb cock), an exhaust port (with a diaphragm having a hole of the same size as the preliminary exhaust port in the engineer's valve), and a direct exhaust, both of which are controlled by a three-way cock. It is also provided with a reliable gauge, the reading of which informs the inspector of the more important points which are

required for an intelligent inspection of the car brake ; it shows him the condition of the check valve, whether the feed ports are free from dirt or not ; when the auxiliary reservoir is charged, and also the condition of the slide valve piston, whether free in action or not, leaky pipes, and permits of both service and emergency applications being made and the results noted.

As before stated, this information is given by the reading of the gauge : for instance, let us suppose the inspector wishes to know the condition of the check valve ; assuming the slide valve piston is tight, if after an entire exhaust of the air in the train line, the exhaust port being closed, the gauge shows an accumulation of pressure, he knows the valve leaks, little or much, according to the speed of the accumulation.

It shows leaky pipes by the gradual falling of pressure after the auxiliary reservoir is charged. It shows feed ports entirely filled with dirt if immediately after the air is turned on and then shut off, there is no falling of pressure. It shows them partly filled if the falling is gradual, since if the ports were free, the air would rapidly expand into the reservoir and the pressure be equalized in the train line.

The other details are obtained in a similar manner by the reading of the gauge, and can soon be mastered by a person of ordinary intelligence.

The information given by this device in relation to the condition of the feed ports is very valuable, since it is important they should be free from dirt and in good condition, the action of the brake entirely depending on the air which passes through them. The writer, in examining cars which were reported as "Brakes not holding," has found this port partly filled with dirt, permitting the air to feed past very slowly — so slowly that after an application of the brake another application could not be made for some time. There are rare cases where this port has been found almost entirely plugged, which is a dangerous condition of affairs. For instance, take the case of a train composed of a few heavy cars descending a steep grade, the engineer makes an application of the brake, then perhaps releases it and soon makes another. If he happens to have one or more of these cars with feed ports plugged, or partly so, the brakes on the cars in question would be useless after the first application, since they would not become recharged in the proper time. For so small a thing the feed port is of great importance, and inspectors should be instructed to look carefully after them ; its location not being in plain view when the valve body is in a car, there is no doubt that they are sometimes overlooked. The writer has met men whose duty was to clean and inspect brakes who did not know of its existence.

The PRESIDENT. This finishes the papers to be presented to-night and the subject is now open for discussion. I see with us to-night a man who always has something to say; I refer to Mr. Kolseth.

Mr. KOLSETH. Mr. President, Mr. Desoe touched on the braking power of a freight car. Here is a thing that the Railroad Managers and Master Car Builders must not forget when freight cars are designed; namely, that the braking force is computed to the weight of the car, and not to the load. I am afraid they will expect too much from the air brake. There is a tendency to build cars of greater capacity. I recently heard of a railroad which contemplated building cars of 80,000 pounds capacity. This is, in my judgment, entirely wrong. A car of that description would probably weigh about 36,000 pounds. Seventy per cent of braking force is about 25,000 pounds; now, if this car has a load of 80,000 pounds, the breaking force to the car and load, with a full application, would be about twenty per cent. A train of twenty-five such carloads would weigh between two and three million pounds, and the handling of the trains would be very difficult with such low percentage of braking power.

Instead of having such monstrosities that are dangerous to handle, it would be far better to build more cars of the normal standard.

The PRESIDENT. Mr. Kolseth, I believe, represents an air-brake company; the car coupler companies are also interested. Is Mr. Sheffield in the hall?

Mr. SHEFFIELD. I do not know whether I have anything to talk about to-night; I have a serious cold and am unable to talk much.

The PRESIDENT. Mr. Rifenburg?

Mr. RIFENBURG. My experience will not allow me to say anything this evening in regard to air brakes.

Mr. KOLSETH. We have here a gentleman from the West, and perhaps some of us would like an opportunity to hear from him; I refer to Mr. Lencke of Chicago.

Mr. LENCKE. I have nothing of interest to say for the benefit of this audience.

The PRESIDENT. The question is open for anyone who has anything to say upon the subject, and we shall be glad to hear from them.

Mr. PARKE. I was impressed with one recommendation which Mr. Desoe suggested to-night, and I do not like to neglect the opportunity to suggest that there are quite a number of things to be considered in reference to the use of ninety per cent braking power on freight cars. This subject has been agitated not a little at different times. The standard braking pressure for passenger cars is ninety per cent, and the standard for freight cars is seventy per cent.

There seems to be a very considerable discrepancy which has more than once led to serious discussion as to whether the seventy per cent limit could not be raised. Mr. Desoe suggests that it ought to be ninety per cent. There are several adverse considerations that are not difficult to understand, although it is at present difficult to show them in degree. It will be readily understood, I think, that where a car is moving the effect of its momentum should be considered. If we assume that this piece of paper is the moving car body, and we suddenly apply a retarding force at the bottom, the momentum of the car body, acting at its centre of gravity some distance above the bottom, tends to tip it forward. This tendency causes a heavier pressure upon the forward truck and relieves the rear truck of some pressure. In other words, if the weight which each truck carries to the rails could be measured upon a scale under such conditions, it would be found that, instead of the two trucks delivering the same weight to the rails, the forward truck would carry considerably more weight to the rails than the rear truck. The proportion of the weight of the car body which each truck carries to the rails depends upon the retarding force, upon the height of the centre of gravity of the car body above the face of the centre plates, and upon the distance between the centre plates of the trucks. There is thus a less weight upon the rear truck than upon the forward truck, during an application of the brakes. There is much less difference with a passenger car than with a freight car, principally on account of the difference in wheel base.

The next thing to take into consideration is the effect of the inertia of the car, as applied at the centre plates of the trucks. The force applied by the car, in virtue of its inertia, to the centre plate of the truck, acting against the resistance of the rails to the motion of the truck, tends to tilt or overturn the truck, and that tendency is measured by the magnitude of the force, by the height of the face of the centre plate from the rail, and by the wheel base of the truck; the shorter the wheel base, the greater the tendency to overturn. The rear truck of the car, therefore, carries considerable less weight than the forward truck, when the brakes are being applied; and, further, the rear wheels of the rear truck carry to the rail considerably less than half the reduced weight upon that truck. The weight carried to the rails by the rear wheels of the rear truck, during brake application, is sometimes as low as eighty per cent of the normal weight. It would hardly do, therefore, to apply to those wheels a braking pressure of ninety per cent of the weight which they normally carry to the rail.

Another possibly important consideration I offer with some diffidence, because it has yet to be fully determined by the Brake Shoe Committee. They have, however, already found sufficient evidence in regard to it

to permit me to suggest it in this connection. It is found that a certain pressure of a brake shoe upon the wheel causes a certain resistance to the rotation of the wheel. If that pressure be divided by two, considerably more than one-half the friction is obtained; that apparently means that if you undertake to apply a ninety per cent brake pressure to a light car, viz., a freight car, it will result in a good deal more friction in proportion to the brake pressure than when a ninety per cent brake pressure is applied to a heavy car, viz., a passenger car. Now it is interesting to know that actual experiments show that, with a calculated braking force of seventy per cent, the rear pair of wheels sometimes slides upon dry rails just before the car comes to a stop. When the Master Car Builders decided upon a seventy per cent braking pressure for freight cars, it was only after that matter had been very carefully studied and experimented upon; and they found that if a greater brake shoe pressure were used, it would be apt to slide wheels when the car is empty.

The PRESIDENT. Are there any other gentlemen who desire to speak upon this subject? If so, we should be very glad to hear anything they have to say, and have them give us their experience. We should be glad to hear from Prof. Swain, whom I see present.

Prof. SWAIN. Mr. President, I came in to listen to-night, and I do not think I can add anything to what I have already heard. It seems to me that every railroad company should adopt everything it can to get the best brakes possible. I was very much interested in the figures Mr. Parke gave, but I do not think I can add anything to the discussion.

The PRESIDENT. There are those here who are well up in the air brake business, and we shall be pleased to hear from them. This is a good place to talk this matter over, when we are all here. Perhaps Mr. Marden could tell us of the progress of freight brake equipment on the Fitchburg Railroad.

Mr. MARDEN. Mr. President, I came in late on account of being up the road, and I am not in very good condition to talk on account of a severe cold. I think that all railroads realize fully the importance of having braking power on freight trains, as well as passenger trains, and in the very best possible order. There is one thing that I have found since we began to use air brakes to any extent, and that is, that they are not properly taken care of; and we, as a road, realize fully the necessity of having air brake inspection plants fully equipped at our terminal and junction points, and I am considering that now. I think that subject, so far as I have been able to hear the papers read, has been well discussed. I am of the opinion that rather than take up the time myself, we should hear from our inspectors. I was very sorry

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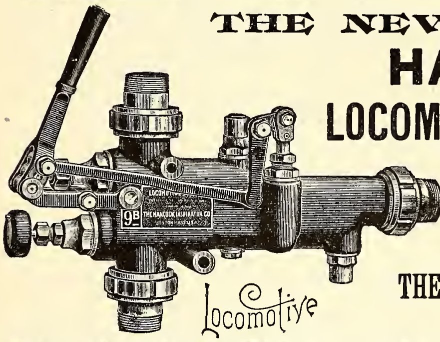

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that our Western friend felt himself out of place here. I am sure that if he will give us some of his experience he will not find himself out of place long.

The PRESIDENT. We should be very glad to hear from him or any one else.

Mr. LENCKE. I do not think that I could say anything that would be of interest to you gentlemen. I do not think that my experience has been anything compared with men we have here. I have made, though, a little study of air brakes. I find it is very important to keep the piston travel at a predetermined limit. Of course you understand I am in the air brake business, and I do not come here to advocate anything that I am connected with, but I would like to say this, that if you will look into the result that is obtained by the different piston travels, I think you will find it quite an important matter to consider. A ten-inch cylinder with four-inch piston travel gives, with ten pounds reduction, about sixty pounds pressure, and when the piston travel is allowed to run out as far as eleven inches we have a pressure in the brake cylinder of only twelve pounds to the square inch, which shows that there is considerable more braking power on one car than another; not that alone, but when you think you are getting ninety per cent on a car you are not getting anything like it. This is the only thing I have got to say. In this line you will have to excuse me; I am a poor talker.

The PRESIDENT. We have with us Mr. Andrews; he may have discovered some "eccentricities" of the apparatus.

Mr. ANDREWS. I have nothing to add to the discussion.

Mr. GRAHAM. The steam railroad men have had a good deal to say about air brakes, and as the electric railway companies also need good brakes, they have been looking around with a view of adopting some standard power brake. One or two different large electric companies have been experimenting with electricity, and at the Montreal Street Railway Convention, an electric brake was exhibited there that seemed to possess many good features. The electric railway people have discovered that the air brake has a good many diseases, and they are not anxious to add to their already complicated mechanism a power brake that will require a separate department, with specially educated men to take care of the equipment. The electric railway companies have a power at their command that not only starts the car, but can be used to control the car. The motors, by a movement of the controller, are converted into generators, the current then being used as a brake power. Although the question of power used to apply the brake is an important one, there is still a question of as much importance to be considered, and that is the foundation brakes.

To the observing railroad man the question of the tilting of passenger car trucks when the brake is applied is a serious matter; the air brake experts declare it does not neutralize the efficiency of the brake, but to the master car builder the question of broken equalizers and equalizer springs is serious.

With the object of preventing the tilting of these brakes, I have, after considerable study, devised a method very simple of keeping the truck frame always level, no matter what the speed of the train nor how severely the brake shoes are applied to the wheels. This is done by using a brake bar, which we call an equalizer. (The cuts herewith show the plan and side elevation.) Fig. 1 shows a plan view, an approximately "U" shaped brake bar or equalizer, three by three-fourths inches; has its inner ends supported and anchored in rubber seated sockets fastened to the truck frame. This is the only connection it has with the truck. The axle boxes have jaws cast solid on them in which rest the brake bar or equalizer.

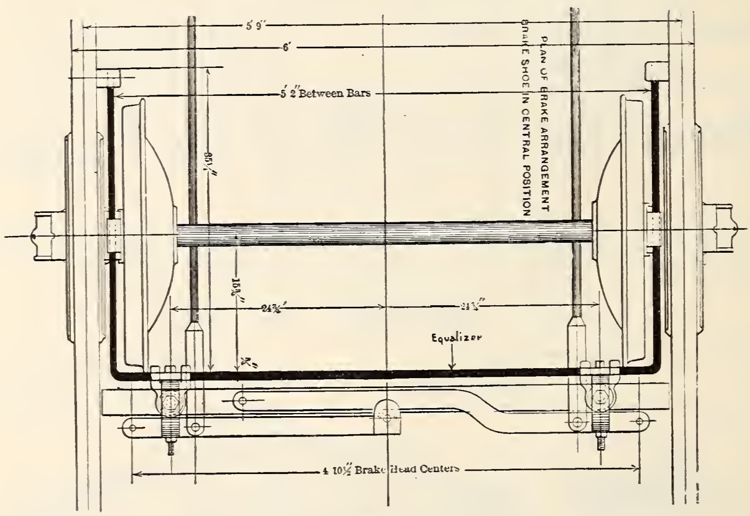

FIG. 1.

On the equalizer back of the wheels are fastened the brackets for supporting the brake beams; there are holes in the brackets to receive the one-inch steel brake beam hangers. On each side of the brackets are one-inch rubber washers in cast iron cups; on each side of the brake beams are two more rubber cushions and cups. Between the upper cup and the check nut is fastened the brake release spring tension, permitting the most delicate and sensitive adjustment.

Fig. 2 shows an elevation of one corner of the truck, with the pedestal cut away to show the jaw on the axle box and position of equalizer, one end of which is fastened in the socket bolted in the truck frame and passes back over the axle box across in the rear of the wheels to the other side of the truck, and then forward through the jaw on the axle box to the socket fastened to the frame.

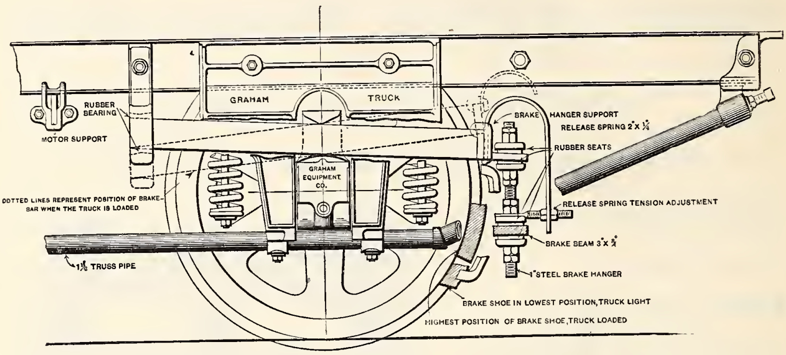

FIG. 2.

The dotted lines in Fig. 2 show position of equalizer when truck is fully loaded. As the shoes are applied to the wheels the forward wheel has a tendency to draw the brake shoe down, carrying the strain over the box to the end of the equalizer fastened to the frame. The rear wheels carry the shoe up, which transfers the strain over the axle boxes to the socket on the truck frame; therefore, where the front wheel has a tendency to pull the end of the frame down, the equalizer exerts the same force to hold the truck frame steady, and where the rear wheels would tilt the truck frame up, the equalizer exerts the same force on the socket fastened to the frame to hold it down, so that no matter how great the power applied to the shoes the truck frame remains perfectly steady. Although the air brake companies declare it makes no difference whether the truck tilts or not, surely if the shoes have a positive fixed position at all times to the wheels there will be a greater retarding force, and the back lash to the car bodies when the trucks straighten themselves, due to the releasing of the brakes, would be entirely removed; then the strain on the truck equalizer and equalizer springs would be entirely removed.

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The President. Mr. Chamberlain, I believe, wants to say something, but is a little bashful about it.

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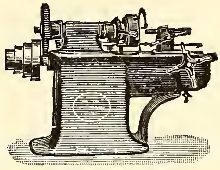

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Mr. Chamberlain. When I read the proceedings of the last Club meeting I made up my mind that I would not say anything more for six months. I was very much interested in the papers read by Mr. Parke and Mr. Desoe, but I certainly feel that I must take exceptions to certain portions of Mr. Desoe's paper, wherein he advocates ninety per cent braking power. It is seven or eight years ago since I was connected with the Albany road, and, unless I am very much mistaken, when Mr. Adams and I looked up the matter of this same subject, we found that the average load for a 21,000 or 22,000 pound car, arriving in Boston (and it was conceded at that time that the Boston and Albany was carrying a greater through freight, and probably is to-day, unless it is the Boston and Maine, than any other railroad in New England), to my surprise, was only between five and six tons. I honestly believe that those people who are building cars weighing 60,000 or 80,000 pounds, are foolish: that when they are building such cars for indiscriminate freight business, they are making a serious mistake. It does not pay. I am of the opinion that the ordinary brake on the freight car is amply sufficient for the present practice. I would like to ask Mr. Desoe to see the General Freight Agent and find out what his average load is arriving in Boston (which is the most important point for all classes of freight), and I venture to guess that to-day it will not be more than seven or eight tons. Now, if the figures are right, the cylinder usually used on freight equipment is amply sufficient to supply all the brake power necessary. There is another point in Mr. Desoe's paper, in which he spoke of damage to trains equipped with brakes being liable to break apart. This I do not understand; because I believe thoroughly when the Westinghouse brake is applied, especially if a man sees a red signal, or something, he stops, if the brake is in order; if it is not in order, it is either the fault of the Westinghouse Co. or the railroad company.

Mr. Desoe. Mr. President, I think Mr. Chamberlain misunderstands me in regard to a partly equipped train causing damage. What I said was this, that a train partly equipped with air brakes may cause a severe shock to the train by the sudden application of those brakes. One of the ways a sudden application may be caused is by the train breaking apart in the air brake portion. We have had several accidents on the Albany road which were caused in this way.

Mr. Chamberlain. What I understand by breaking apart is the link and pin separating.

Mr. Desoe. Yes; that is just what I mean, the pin or link breaks, and the breaking apart of the air hose follows, which permits the train line air to escape, causing the brakes to apply suddenly, and stop the equipped part of the train, the rear part running into it, causing a very

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severe shock. Now in regard to ninety per cent braking power. I would say my conclusions were drawn from observations in practice. Mr. Parke's, I think, are mostly from theory.

I have observed trains descending quite heavy grades, with cars *loaded*, not with five or six tons, but thirty tons, and at the present time of year there are plenty of trains running with such carloads of grain, which make a very heavy train, and it is on such trains I have observed that the breaking power is not sufficient to make good stops, and I came to the conclusion that it should be more than seventy per cent. Mr. Parke's explanation, however, has caused me to look at it in a different light.

The PRESIDENT. Are there any others present who will speak on this subject?

Prof. ALLEN. Mr. President, I have been very much interested in the papers we have listened to, and especially in Mr. Parke's paper, which seems to me to be thoroughly scientific throughout, as is the rule with papers either read by Mr. Parke before societies or contributed by him to periodicals. I was especially interested in the point which he brought out in relation to the use on freight cars of seventy per cent instead of ninety per cent, that in braking a train a greater proportion of the weight was brought on the forward trucks, and to the further point, that a greater proportion of weight was brought upon the forward wheel than upon the rear wheel of each truck. It seems to me that it is not easy to get rid of the difficulty he speaks of, so far as the greater proportion of the weight on the forward truck is concerned; but it seems to me that it is possible, theoretically, at least, to get rid of the difficulty as far as the forward wheel of each truck is concerned. I remember several years ago Mr. Parke wrote a paper, which I saw in the *Railroad Gazette*,* in which he called attention to "Some Unconsidered Elements in the Action of Brakes." He called attention to the fact that the pull on the rod is horizontal instead of normal to the wheel; taking this into account and combining with the effect of the friction between the brake-shoe and the wheel, he found that the actual pressure normal to the wheel was not ordinarily the same on the forward as on the rear wheel; and in that paper he showed how it was possible, by arranging the position of the hangers, to bring the same pressure upon the forward wheel as upon the rear wheel of the truck. Now, it seems to me that if it is possible, by arranging the position of the hangers, to secure *equal* pressures on both wheels, then it is possible to arrange those hangers in such a way that the pressure on the forward wheel of the truck shall be *greater* than upon the rear wheel of the truck, and greater by the amount that you want to have it. It seems to me possible to arrange the position, or angle, of the hangers just right, in order

*Oct. 24, 1890.

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to bring about the result that you wish to have; to secure just the difference required in the amount of pressure, as well as to make it greater upon the forward wheel than upon the rear wheel. Difficulty will exist, of course, on cars now in use with brake hanger as now attached, and if you should attempt to use more than the seventy per cent with them, perhaps somewhere on the train you would cause a rear wheel to skid when its front wheel did not. If the matter is worked up right, it is possible to avoid that part of the difficulty resulting from the difference in pressures on the two wheels of the same truck, and I would like to ask Mr. Parke if that is not the case.

Mr. Parke. Mr. Chairman, I think that the speaker takes a view of the matter which is susceptible of being carried out in the way which he describes. Unfortunately, however, we have a condition in railroading that sometimes the car runs in the other direction (*applause*), and in that case the forward wheel becomes the rear wheel, and the rear wheel the forward wheel. (*Laughter.*)

Prof. Allen. Mr. President, as I understand it, when a car is turned, the forward wheel is the wheel that is at the head of the truck as the truck runs. Now, the suggestion I made is, that the hanger shall be placed in such a position that in each case the pressure on the forward wheel in running shall be always greater than upon the rear wheel in running. I do not mean the wheel at the north end of the car shall always have the greater pressure, but the wheel which is the forward wheel in running shall always have the greater pressure; and I would like to ask Mr. Parke if he can use his hanger in a way to get equal pressures, —whether he cannot arrange it differently, and in a way to secure greater pressure upon the forward wheel than he does upon the rear wheel.

Mr. Parke. I think there is no question about that, if I understand aright now. It could also be done by difference in the leverage of the truck levers themselves, so that the wheels near each end of the car should have the less brake-shoe pressure. This would, however, entail a heavier pressure upon the rear pair of wheels of the forward truck of the car, in whichever way it was running, and it might be a serious question if that would not introduce complications which would perhaps more than offset the advantage gained to the rear truck. I would not like to say off-hand that it would; but it might produce such a complication as I have suggested.

The remarks made by Mr. Chamberlain seem to call for just a little bit of explanation. I do not feel as though it is really an unpleasant position to be placed in, to be represented as connected with a concern which endeavors to keep up with the times. We have tried always to furnish a brake apparatus that would, as near as possible, meet the requirements of the times in which it was used. Regardless of

criticisms for making changes, we believe it best to keep pace with the times and thereby to be on the safe side. I remember a little story that will illustrate the importance of keeping on the safe side in railroading. In the early days of railroading on the Pennsylvania, before it was double tracked throughout its entire length, a freight train was going west, and, reaching the end of the double track, it had to wait at that point for the "Fast Line" coming east. There was no telegraph station, and no way of getting orders; so the boys hauled up at the end of the double track, and, in order to keep themselves advised, they stuck a stick in the middle of the eastbound track, so that if the eastbound train went by it would knock the stick down. The conductor took some rest in the caboose, and the engineer stretched himself out in the cab. After a while the conductor awoke and, looking at his watch, found that an hour had gone by. He hurried up to the front of the train, and the stick was still standing up; and he then aroused the engineer, saying, "Henry, the Fast Line is more than an hour late now; what are you going to do?" Henry replied "We will wait here just ten minutes longer, and if she aint here then we will wait until she come." (*Laughter.*)

Prof. ALLEN. Mr. President, I would like to speak just a moment to be sure that I was understood as to the brake hangers. I mean, to arrange the hangers in such a way that they shall make the same angle on each side of the truck; as you vary the angle you will vary the pressures that you get on the different wheels, and still keeping the angle the same on each side of the truck, you can make the difference in pressures just what you want to.

The PRESIDENT. Is there anything further to be said upon this question? If there is any other gentleman who wishes to speak, now is an opportunity, if he does it quick.

Mr. J. H. SEWALL. Mr. President, I perhaps can say something for the benefit of all concerned, and that is in relation to the foundation brake rigging. I have had occasion lately to equip two separate cars with a certain device, and have found that it is the practice of the car manufacturers (I do not mean the Master Car Builders) to make their draw rods of an equal length. In one case I found the tie rod 48 inches long, and in another case the tie rod 36 inches long. As we all know the length of a ten-inch Westinghouse cylinder has been just the same ever since it was first made, no-longer and no shorter, the requirements of this difference in the length of tie rod is questionable. The draw rods being made of an equal length by the manufacturers, and the air cylinder being placed where they could get a convenient timber to bolt to, the cylinder was not necessarily placed in the centre of the car. This left one short draw rod and one long one, or in case of two long draw rods, the tie rod had to suffer.

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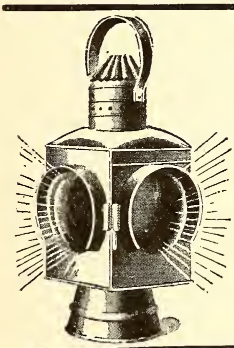

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LACONIA, N. H.

The PRESIDENT. The subject for the next meeting will be the "Number and Location of Grab Irons or Hand Holds and Height of Drawbars, as applied to Freight Cars."

The meeting adjourned at 10 o'clock P.M. Eighty-seven members present.

The following letter in explanation of a part of the discussion has been received since the meeting, and is appended for its bearing upon the discussion: —

NEW YORK, N. Y., Nov. 13, 1895.

MR. EDWARD L. JANES,
Secretary NEW ENGLAND RAILROAD CLUB,
Boston, Mass.

Dear Sir: — A subsequent personal explanation of the views expressed by Professor Allen at the Club meeting last night showed me that I had wholly misunderstood what he said, and I must confess that my apparently persistent misunderstanding of it really amounted almost to obtuseness.

The suggestion offered by Prof. Allen in his remarks seems to me to be entirely reasonable and of possible practical utility. Without giving the matter more detailed consideration, however, it would be impossible to judge whether there are practical or constructional difficulties that would interfere with reducing the suggested principle to practice. Objections readily occur to me concerning its application to outside hung brakes; but, for inside hung brakes, Prof. Allen's suggestion may be worthy of careful investigation.

Although the writer has already claimed more attention in the discussion of the evening than modesty would suggest, he would be very glad if you can conveniently incorporate this communication in the report of the meeting, to correct any misapprehensions which might result from the apparent, though unintentional, irrelevancy of his replies to the questions of Prof. Allen.

Very truly yours,
R. A. PARKE.

NEW MEMBERS.

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Goodrich, Ira B., N. Y., N. H. & H. R.R., Kneeland Street, Boston, Mass.

Green, Geo. A., Train Despatcher, B. & A. R.R., Worcester, Mass.

Hannaford, Parker W., Car. Dept., Maine Central R.R., Waterville, Maine.

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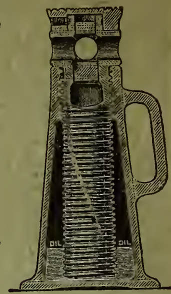

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OPERATION OF RAILROADS.

PAPERS BY

JAS. F. McELROY, DR. LOUIS DUNCAN, L. H. PARKER, CALVERT TOWNLEY.

Meeting of Feb. 11th, 1896.

Published by the Club,

EDWARD L. JANES, SECRETARY, P. O. BOX 1158, BOSTON.

Annual Meeting, Tuesday Evening, March 10, 1896.

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JOHN T. CHAMBERLAIN, President	"	1893,	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, February 11, 1896.

The President, Mr. L. M. BUTLER, called the meeting to order punctually at 8 o'clock, and said :—

The first business before the meeting is the approval of the minutes. The minutes no doubt you have all seen in the printed report. If there is no objection, I will declare them approved. The next business is reports of committees. Are there any committees to report? Hearing none, we will pass it. The next is unfinished business. Has any one any unfinished business to offer? If not, we will pass it. The next is new business. Under the head of new business our Secretary has some correspondence which we will hear read.

The SECRETARY. I have a letter from Dr. Louis Duncan, electrician of the Baltimore & Ohio Railroad. Under date of February 6th, he writes as follows : —

820 Equitable Building, Baltimore, Feb. 8, 1896.

MR. EDWARD L. JANES,

Secretary NEW ENGLAND RAILROAD CLUB, Boston, Mass.

Dear Sir:—I am exceedingly sorry that it will be impossible for me to be with you on the 11th inst. As promised, I send you enclosed a short paper on the B. & O. electrical equipment. Mr. L. H. Parker, of the General Electric Co., who installed this work, was in my office to-day, and I learned that we were both invited to be present at your meeting to take up the same subject. He has offered to read my paper and to enlarge upon it in his address. Again regretting that I cannot accept your kind invitation, I am,

Yours very truly,

LOUIS DUNCAN.

I have a letter here from N. H. Heft, written to your President.

New Haven, Conn., January 29, 1896.

L. M. Butler, Master Mechanic,
Auburn, R.I.

Dear Sir: — Your kind invitation to read a paper or say something on the question of electricity vs. steam at hand.

I find it will not be possible for me to be present at your meeting of February 11th. If you so desire, and will name some later date, I will try to make my arrangements so that I can be present.

Yours truly,
N. H. HEFT,
Chief of Electrical Department.

I have also a letter from Mr. A. L. Plimpton.

Boston, Mass., February 6, 1896.

Mr. Edward L. Janes,
Secretary New England Railroad Club.

Dear Sir:— I desire to thank you for your very cordial invitation to be present at the next meeting of the Club on the evening of February 11th, and I certainly should be much interested in hearing the discussion of the subject which has been selected; but I regret to add that I shall be unable to be present, as I have a previous engagement for that evening.

Very truly yours,
A. L. PLIMPTON.

The President. If any person has anything to offer under the head of new business, there is now an opportunity. Appointment of committees. There was a nominating committee to be appointed, our next meeting being our annual meeting for the election of officers. The Secretary will read the appointment.

The Secretary. Your President appoints the following members for the nominating committee: F. D. Adams, J. T. Chamberlain, F. M. Twombly, F. E. Barnard, C. W. Sherburne.

The President. The next business is the discussion of the subject announced, "The Substitution of Electricity for Steam as a Motive Power in the Operation of Railroads." I will now introduce Mr. McElroy, of Troy, N.Y., who will open this discussion.

ADDRESS OF MR. JAMES F. McELROY.

Mr. President, I may illustrate the mechanical motion produced by an electric current by referring to the skill of the base ball pitcher who so delivers a ball that it will curve its path in any direction he may see fit to send it. The particular curve which the ball will follow in its flight will depend upon the twist or rotary motion given it as it leaves the hand of the pitcher.

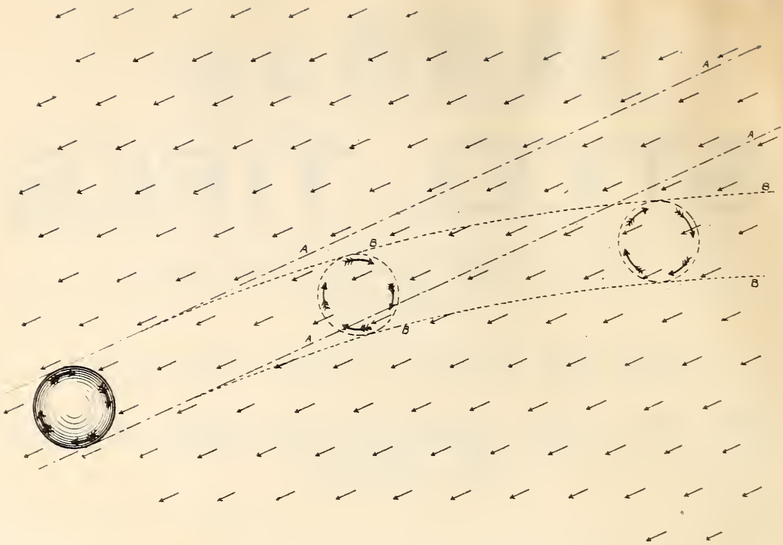


Fig. 1. Showing Effect of Rotation on a Ball moving through space.

Fig. 2. Photograph showing Arrangement of Circular Lines of Force about a Wire carrying an Electric Current.

Figure 1 gives an illustration of the well known fact of which I speak. Let us suppose the ball moving out into space in the direction indicated by the straight lines at the same time a motion of rotation is given it in the direction marked by the curved arrows. It is well known that the rotation of the ball causes the air to react upon that part moving forward most rapidly, so as to drive the ball at right angles to its path and cause it to follow a curve as indicated in the figure. I refer to this well known fact simply for purposes of illustration, as it furnishes us an example in which an original impulse produces motion of a body in a

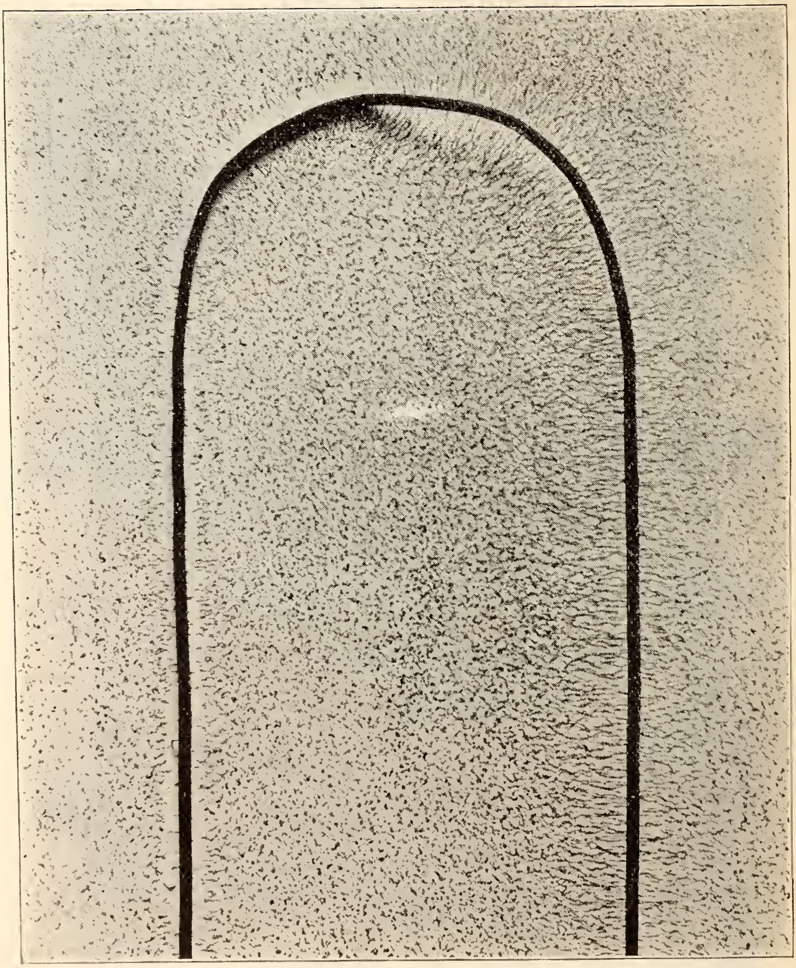
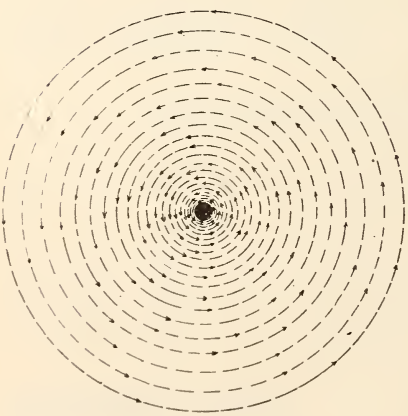


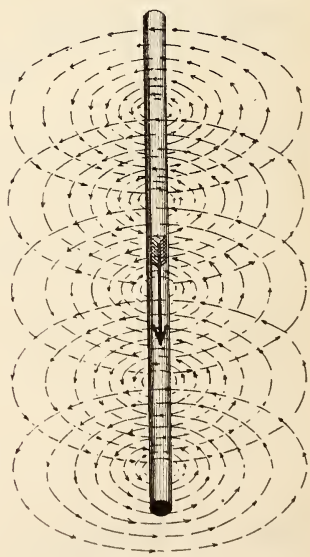
Fig. 3. Photograph of Iron Filings in Lines of Force at Right Angles to Wire carrying Electric Current.

straight line, and at the same time the medium through which it passes, causes a motion in a line at right angles to the line of propagation. I introduce this to illustrate an action which takes place between a wire carrying an electric current and the field of force in which that wire may happen to be placed. Before we make full application of the illustration, however, let us consider for a moment some of the phenomena of current-carrying wires.

Let us place a wire in a vertical position and through it send the electric current. In a horizontal position about this conductor we place a sheet of paper which is stretched upon a suitable frame-work, the wire passing up through the sheet of paper at about its central point. While the current is passing through the wire we sprinkle iron filings over the surface of the paper and, by jarring it slightly, we cause the filings to arrange themselves in curved lines about the wire itself. These curves extend out for a distance of six or eight inches from the wire in all directions, and even indications of this arrangement may be found extending out on the paper to a much greater distance. If we place a loop of wire carrying the electric current flatwise upon the sheet of paper, as is shown in Figure 3, we will find that where the loop rests upon the paper the particles of iron are attracted to the wire, leaving the space near the wire without iron filings. Under that portion of the



Sectional View.



Perspective View.

Fig. 4. Showing Direction of Magnetic Lines of Force surrounding a Current-Carrying Wire.

loop which is supported about one half inch above the paper, we find that the particles are not drawn to the wire, but they arrange themselves in straight lines across the path of the wire. This fibrous arrangement of particles may be traced for a considerable distance at right angles to the conductor.

The position and direction of the lines which form about current-carrying wires may be more clearly comprehended by referring to Figure 4. Here is represented a wire in which a current flows in the direction indicated by the arrow. The circles represent the position of the lines which form at all points about a wire carrying a current of electricity. These lines are also represented as they appear when looking at the end of the wire. The question will then suggest itself as to what are these lines, and why do particles of iron array themselves in circles about conducting wires?

By testing with iron wire we discover that the particles of iron are magnetized, and that the attraction between the positive and negative poles of the magnetized particles is the force that collects and holds them in circular lines. These lines are, therefore, said to be lines of magnetic force, and they are the lines in which magnets will place themselves when suspended freely in the presence of conducting wires. These lines are sometimes known as magnetic whirls, because of their circular form and because they exist in such large numbers and of diameters varying from the smallest fraction of an inch up to several feet. The darts on the lines of force in Figure 4 indicate the direction in which the positive poles of the magnetized particles extend, and also indicate the direction in which the positive pole of the magnetic exploring needle always points. By following the direction of the exploring needle the path of these lines through space may be traced. The direction of the magnetic lines will be reversed on reversing the direction of current through the wire. As I have already intimated, these lines are magnetic lines of force, and the space in which they form about the conducting wire is known as a magnetic field of force.

By pursuing our investigation further, we discover that magnetic lines of force are not confined to the neighborhood of conducting wires, but they are to be found in all space in which magnetic attractions or repulsions take place.

The next step in the development of the electric motor will be to show the existence of lines of force in the space surrounding magnets. To do this, I place an electro magnet on the floor with its poles in an upright position. I then place on the poles in a horizontal position a large draughting board on which I have stretched a sheet of white paper. When the magnet is excited by sending a current of electricity through its coils, I sprinkle over the surface of the paper some fine iron

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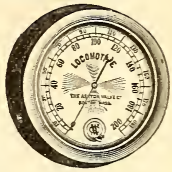

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filings. For this purpose, I found it convenient to use the iron chips that come from the emery grinder. By jarring the board slightly, we find that the particles of iron outline the pole pieces, and array themselves in beautiful curves, as shown in Figure 5. These lines may be traced over a surface at least six feet each way in splendid curves, of which Figure 5 is a photograph. Now, the lines of this figure are found

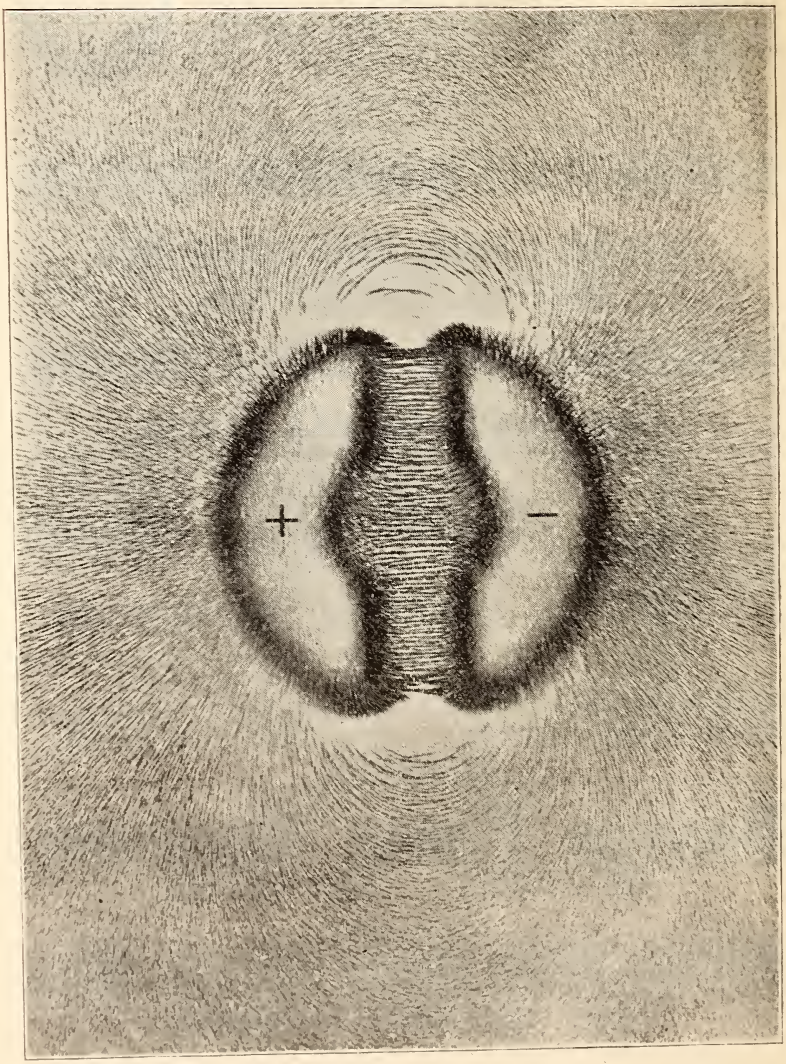

FIG. 5. Photograph of Field of Force surrounding Unlike Poles of a Magnet, showing Curved Lines of Force terminating in the Unlike Poles.

to be magnetic lines of force and to be identical with the curved lines which formed about wires carrying electric currents. The lines of force emerge from the positive pole of the magnet and sweep out into space in curved paths which always terminate in the negative pole. Many lines extend in the short path directly from the positive to the negative pole, and are marked by the dense accumulation of iron particles between the poles. Many lines follow the short curves between the poles, and are so dense, and pull at such an angle, that they draw the filings from the region near the poles to the poles themselves. This accounts for the absence of filings of iron near the poles at opposite sides of the magnet. Lines of force exist in these localities and were so strong that the filings would not stick to the paper. The lines above the edges of the pole pieces stand up like bristles from the surface of the paper. I have already stated that the lines of force extend from the positive to the negative poles of the magnet.

We will now change the connections to one arm of the electro magnet so as to make both poles of the magnet near the sheet of paper positive, and we will see what change is made in the lines of force.

Figure 6 shows the result. You will see now the lines do not extend from one of our pole pieces to the other, but that they go out in all directions from both poles alike. The lines disappear from the space between the pole pieces since they have like polarity. These lines of force extend out into space in curved paths and return to the lower end of the magnet near the floor, which is now the negative pole.

By continuing the investigations further we will learn several things in regard to lines of force.

1. Lines of force never cross nor intersect each other.

2. There are found to be about 120,000 lines of force per square inch in a piece of soft iron which is magnetized to its fullest extent.

3. Lines of force from the same or like poles repel each other and also repel like poles themselves, while lines connecting unlike poles draw the unlike poles together.

This is the law of attraction and repulsion of the magnetic lines of force and it forms the basic principle upon which the operation of the electric motor depends. I cannot tell you why the lines of force act as they do; I cannot tell you as to what is the nature of the magnetic lines, or how or why these magnetic lines are excited by the electric current. These questions are involved with questions as to the ultimate nature of force and as to its relation to the forms of energy known as electricity, magnetism, light and heat, and mechanical motion. Concerning these questions theory alone has been able to deal, and as to electricity and magnetism even theory has not yet been able to offer satisfactory explanations.

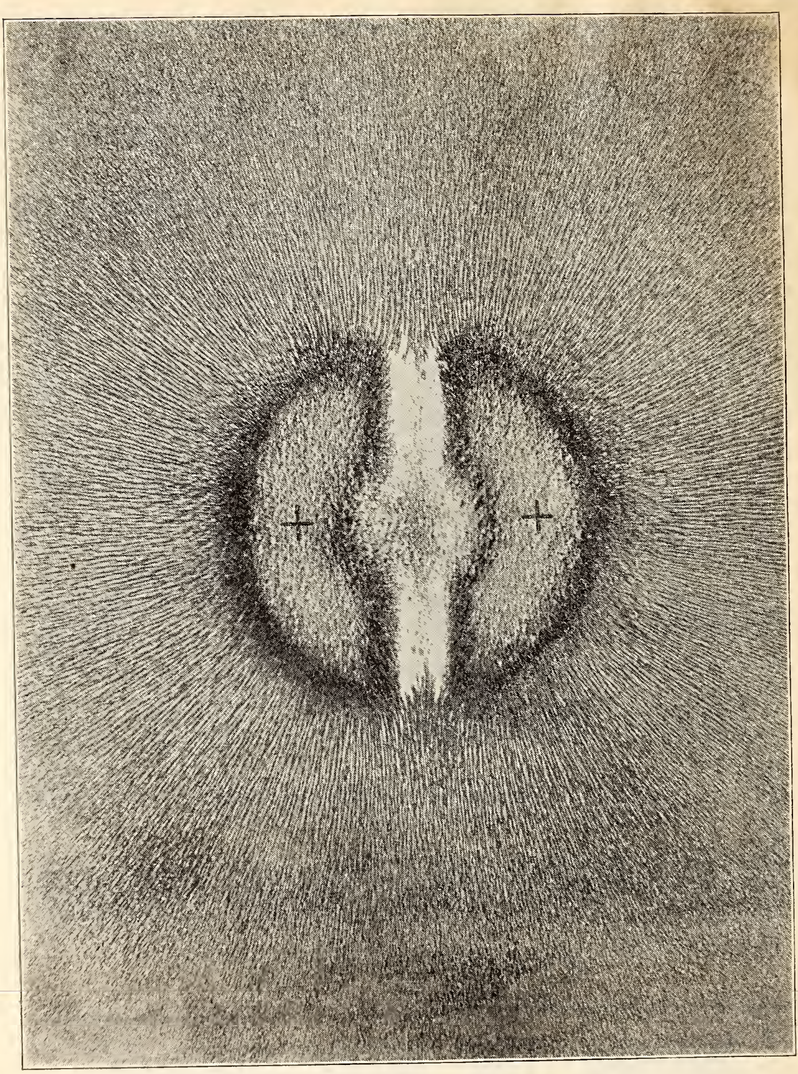

FIG. 6. Photograph of Field of Force surrounding Like Magnetic Poles, showing Repelling Force between Lines from Like Poles.

In developing the principles of the electric motor, it is my purpose to start with the attraction and repulsion caused by lines of force, and accepting these as facts established by experiment, to show how they may be applied to produce motion in the motor.

The attractions between unlike poles has already been referred to. It is a matter with which no doubt you are all familiar, as the attraction

between a magnet and its keeper is a matter of common knowledge. By referring to Figure 5 you will note the appearance of the lines of force between two unlike poles between which there is a powerful attraction. You will note the mass of lines extending directly between the two poles themselves. You will also note the great number of lines that extend out into space in curves which terminate in opposite poles of the magnet. Now, these lines would all bunch together and take the short

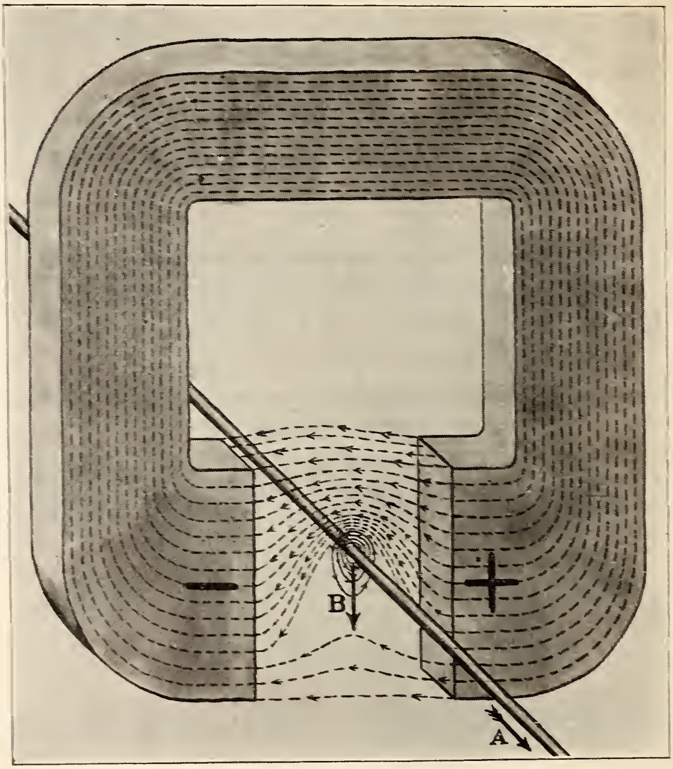

FIG. 7. Showing Effect of placing Wire carrying Electric Current in Field of Force of a Magnet.

est path between the two poles were it not for the repulsive action between the lines themselves. It is this repelling force that drives lines into space remote from the magnetic poles. The lines which spring from the positive pole not only repel each other, but they also repel the lines from the positive pole of another magnet, so that each line occupies the shortest path that it can occupy considering the repulsive force that exists between it and neighboring lines from the same pole.

By referring to figure 6, in which the two upper poles are alike, both

being either positive or both negative, you will note the lines which radiate out from these poles. They do not take the shortest path between the positive and negative poles on account of the repulsion between lines. You will see that the whole arrangement of lines in this diagram indicates a repelling force between them, and the poles of the two magnets, both of which are marked positive, repel each other with a very strong force.

I desire now to show you what takes place when we combine the field of force which forms about a current-carrying wire and the field of force between the poles of a magnet. I therefore place within the field of force of a magnet a conductor of electricity through which a current moves, in the direction shown by the arrow A of Figure 7, and let us observe the result. We first note a pull upon this wire in a downward direction as indicated by the arrow B, and this pull upon the wire continues so long as the current passes through the wire. If we cut off the current from the wire, the pull ceases and the wire hangs without greater tension upon its supports than if the magnet were not present. If, now, we reverse the direction of current through the wire, the pull upon the wire is again exerted, but this time in an upward direction and opposite to that indicated by the arrow B; in other words, reversing the direction of current reversed the direction of pull upon the wire. By carrying our experiments further, we will find that by reversing the poles of the magnet we also reverse the direction of pull upon the wire, the direction of current through the wire remaining the same. Here, then, if our wire is supported so that motion can take place, we obtain a mechanical movement of the wire by sending a current of electricity through the wire when placed in a field of force.

I desire to remind you that the action here is similar to the action of the base ball propelled through the air, in which we found a side pull in a direction perpendicular to the line of motion. You will observe that the action of the electric wire in the field of force is an action at right angles to the line of flow of current, and also at right angles to the lines of force of the magnet. It is for this reason that electric induction effects were for a long time extremely difficult to comprehend. I think, however, that we can understand from the illustration of the curve of the ball that the same effects may be produced in mechanical motions. We are also led to the conclusion that, like the action of the base ball, the side pull upon the wire in the field of force depends upon the reaction of the medium in which that wire is placed.

The side pull upon the wire carrying an electric current, without regard to its cause, is the first element of motion of the electric motor. When embodied in a suitable apparatus, its effects may be enlarged to any extent commensurate with the intensity of the current and of the

field of force of the magnet. Before proceeding to apply this principle in the construction of apparatus, let us consider the cause of the pull on the wire carrying an electric current. Figure 7 represents the lines of force due to the magnet as proceeding from the right to the left, or from the positive to the negative pole. The circular lines of force about the wire, caused by the electric current in the direction of the arrow A, ex-

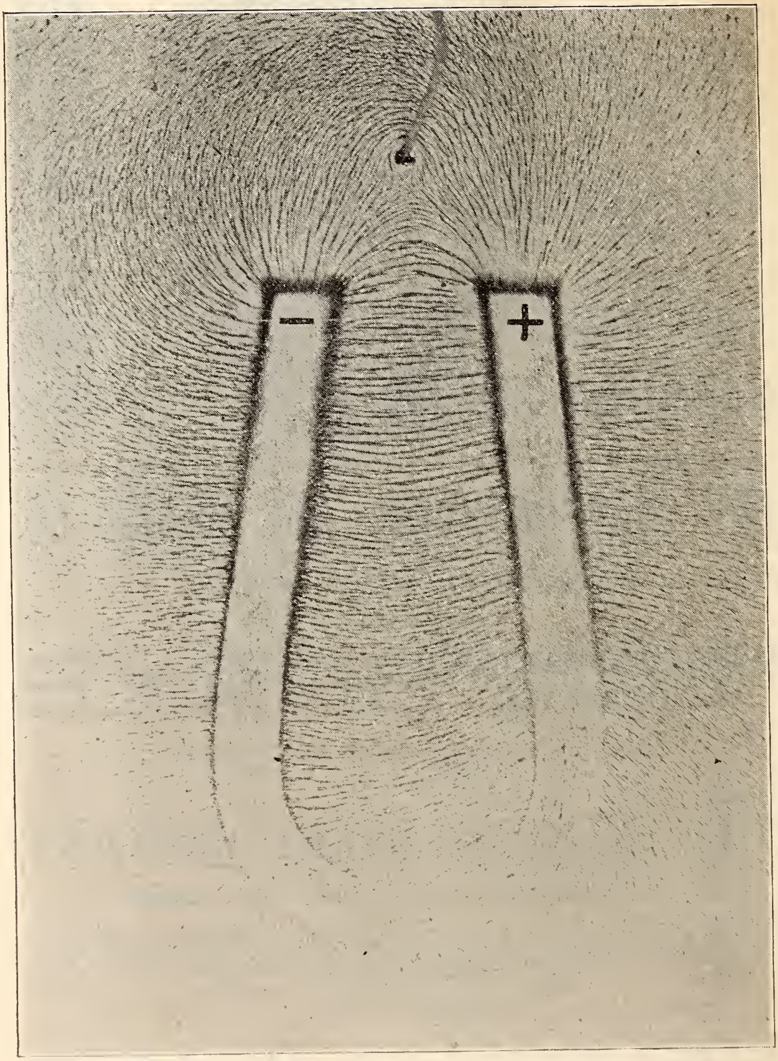

Fig. 8. Photograph of Lines of Force of the Magnet drawing the Wire carrying Electric Current.

tend to the left above the wire and to the right below the wire. We will represent only a few of these lines in Figure 7 to prevent confusion in the drawings. It is evident that the effect of the two fields of force

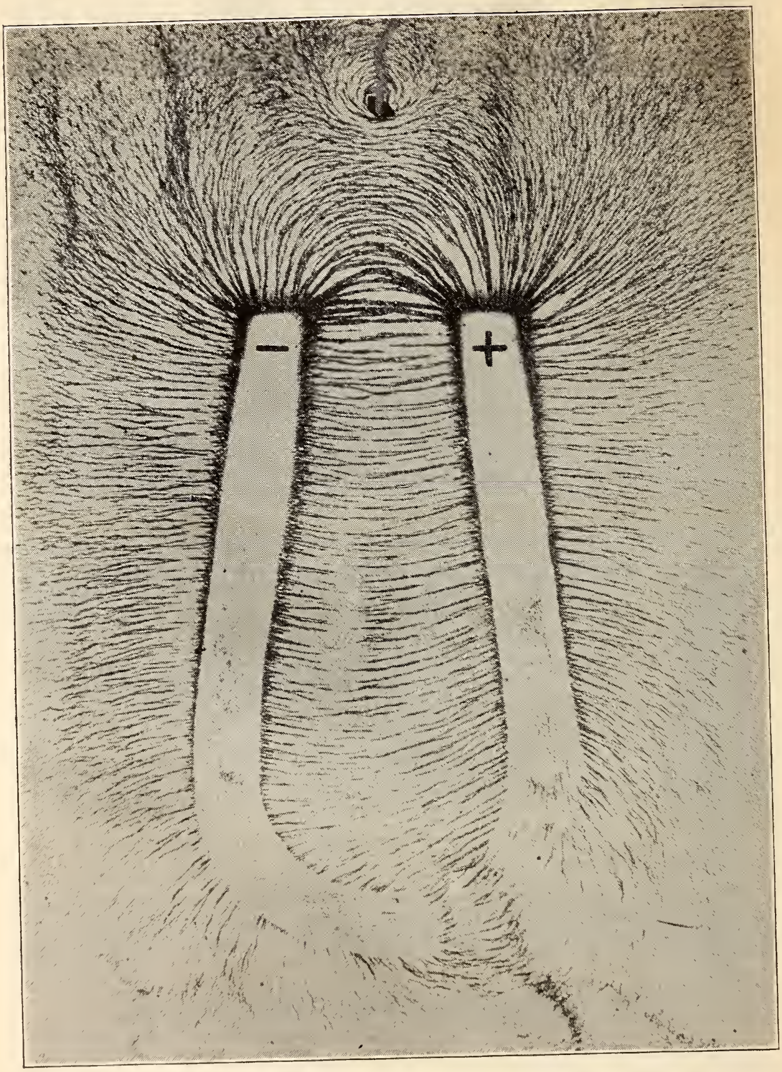

FIG. 9. Photograph of Lines of Force of Magnet repelling the Wire carrying Electric Current.

is to send lines in the same direction above the wire and in opposite direction below the wire. Now, as the lines of force may be considered

as made up of a series of magnetized particles having the positive poles in the direction of the arrows, it appears that the like magnetic poles of the particles above the wire will lie in the same direction. From what we have already seen the arrangement of like poles would result in a repulsion between lines which would drive the wire downward. On the under side of the wire the effect would be different, as here the lines of force of the two fields extend in opposite directions, so that unlike poles of the magnetized particles lie in the same direction. This, we know, results in an attraction. The combined results, then, of the lines of force due to the current in the wire and the lines due to the magnet is to create a pull on the wire downwards. On reversing the direction of the current in the wire, and consequently the direction of the lines of force around it, the combination of the two fields would result in an upward pull tending to lift the wire out of the field of force.

We will further illustrate the effect of a wire carrying an electric current upon a field of force by referring to Figure 8, which is a photograph of lines formed in iron filings. We see here the looping of lines from the magnet around the wire, which indicates that there is a pull tending to draw the wire toward the magnet. The direction of the lines indicate that the current in the wire is from the paper toward the observer. By examining closely you will see the absence of lines on the magnet side of the wire, showing that the lines of force due to the magnet and those due to the current in the wire have here opposite directions. This means that there is here a pull on the wire. In Figure 9 the direction of the current is reversed, and a careful examination of the lines around the wire will reveal the effect. On the side of the wire toward the magnet the lines due to the magnet have the same direction as those due to the current and consequently a repulsion results driving the wire from the magnet. This effect is increased by the pulling action of the lines of force on the opposite side of the wire.

We will now consider some of the principles of construction necessary to render the side pull upon our wire effective in producing motion. Figure 10 represents a magnet in which two gaps are made, with the intermediate block of iron between the gaps. The lines of force which pass throughout the entire magnetic circuit form in both of these gaps fields of force. If, now, I place in the first gap a conductor of electricity and through it send a current in the direction indicated by the arrow, there will be a pull upon the conductor in an upward direction, as shown by the three arrows. If, then, this wire be allowed to return through the second gap to the starting point and the current be passed through it, we will then find a pull on the wire in this gap in a downward direction. It is evident, then, that in this loop of wire connected to the two-part commutator, we have, so far as the current and its action

on the field of force is concerned, a tendency to rotate the loop of wire. Rotation would undoubtedly take place if our apparatus possessed the mechanical qualifications for motion of this kind, and it is to one of the

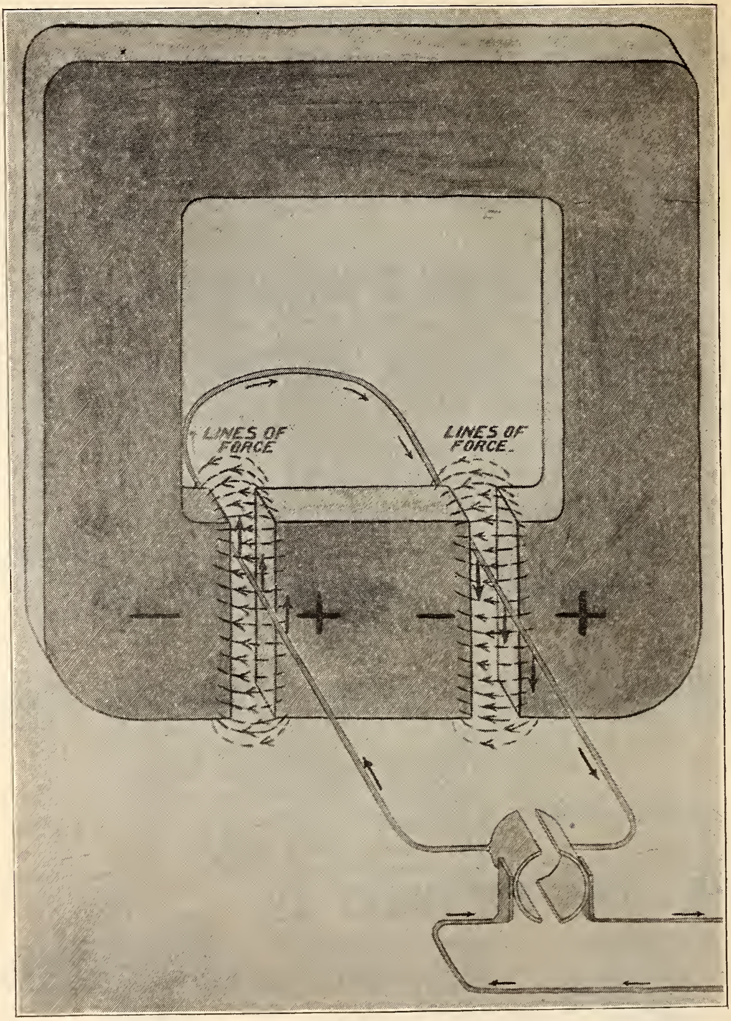

FIG. 10. Showing the Effect of Electric Current on Wire Loop placed in Field of Force of a Magnet.

difficulties encountered in the building of motors to which I now desire to call your attention. If the gaps between the poles of the magnet and the intermediate block of iron were of such a shape as to permit a rotary motion of the wire, we would still find difficulty in rotating the

loop of wire on account of the presence of the iron block within the loop. It must be apparent that since the loop is a closed loop, it would be impossible to support the intermediate block unless that block were supported on the rotating part of the motor. The difficulty here referred to is purely mechanical and not electrical. Some one might suggest that the best way would be to leave out entirely the intermediate block of iron. To this we would object as the presence of the block

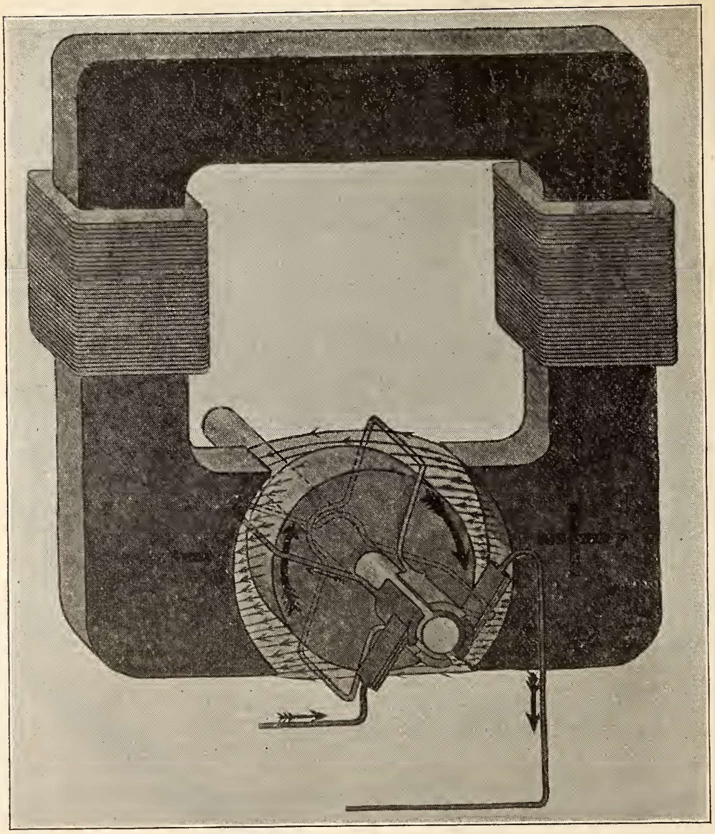

FIG. 11. Rotation produced by Electric Current in Wire Loop placed in Field of Force of the Magnet.

of iron is necessary to make the intermediate fields of force strong and effective. If the block were removed, the action of the current-carrying loop of wire in the magnetic field of greatly diminished strength would be very feeble. It is, therefore, not practicable to adopt a construction in which this intermediate block is left out. We are, therefore, under

the necessity of supporting the iron block upon the same shaft that carries the rotating loop. This step in the development of the electric motor is represented in Figure 11, in which our wire loop is mounted upon a circular iron block carried by a shaft upon which both the wire and iron block can rotate. The gaps in the magnetic circuit are made of circular form so as to embrace opposite sides of the iron core, and sufficient space is left in which the conducting wires can rotate without danger of contact of the wires with the pole pieces.

The commutator shown in this drawing is so arranged that in all positions of these loops the current passes from us through the left gap and to us through the right gap, causing a motion upwards on the left and downwards on the right. Two separate loops are here shown and are arranged so as to be independent of each other. They are also placed at right angles to each other, so that when one loop is thrown entirely out of the field of force no current will pass through it, but the current will always pass in the proper direction through the loop in position of greatest activity.

It should be borne in mind that the pull which causes rotation of the armature is not a pull upon the iron core of the armature, as many people suppose, but is rather a pull upon the wire of the loop itself, or rather that part of the loop which lies in the field of force. It is evidently necessary, then, that we strongly support the wire on the face of the iron core so as to prevent the pull on the wire from stripping it from the face of the armature.

In unfolding the general principles of the electric motor, I have endeavored to do so by directing attention to its essential elements. The results so far is a motor of feeble activity, but which is capable of enlarged results by improvements in details.

Before proceeding to the discussion of the details of the motor, I desire to call your attention to the fact that a line of force is a continuous line formed into a loop. The lines of force pass much more readily through iron or steel than through air, and they extend through the entire circuit of iron and through the magnetic gaps in the magnet. They only appear, however, outside of the iron of the magnets at those points where the iron is discontinued, and there they form the field of force of which I have already spoken. If these lines were to be shown throughout their entire length they would be shown as loops of lines, the larger part of which would appear within the metal of the magnet. In Figure 7 these lines are shown as extending through the entire magnetic circuit.

The question then arises as to in what way may the effect of the pull upon the wire carrying the current be magnified so as to develop the powerful motors which are in use to-day. In the first place, we will

find that, if the number of lines of force be increased, the pull upon the wire loop would be increased proportionately. In other words, if our field of force is made up of twice the number of lines, the pull upon the loop will be made twice as great. Looking to improvements, then, in the magnetic circuit, we first reduce as much as possible the width of air gap in the magnetic circuit. We do this by allowing the wire to run as near as possible to the pole pieces of the field magnet. Care must be taken, however, that under no circumstances should the wire be allowed to touch the pole face.

In the second place, we increase the number of lines by making the pole face of the magnet as large as possible. As about 30,000 lines of force per square inch of pole face is the usual magnetic intensity employed, it is evident that the total number of lines of force is proportional to area of the pole faces.

In the third place, we increase the number of lines by using, instead of a permanent steel magnet, a soft iron or soft steel magnet, and then excite this magnet by the current passing through a coil of wire which is placed around the magnet, as shown in Figure 11. The number of lines per square inch may be increased perhaps four times, by making an electro magnet of it, over the number of lines in a steel magnet of the same size.

In the fourth place, we increase the magnetism by selecting metal for the magnet of the greatest magnetic permeability, or a metal which will give, with a given current in the field coils, the largest number of lines of force. A pure quality of soft iron gives the best results.

Fifth, we increase the number of lines of force by making the magnetic circuit as short and compact as possible. This circuit may be given numerous forms, but the distance through which these lines extend should, in good designs, be made as short as possible.

Now, after we have increased the pull, or what may be called the torque or twisting movement of the loop, by increasing the lines of force to their greatest extent, we will then consider in what other ways the effectiveness of the motor may be increased. We find that we can increase the effect of the motor by increasing the number of loops of wire on the armature, and instead of having a single loop, as is shown in Figure 11, we will have a large number of loops, each wire of which is drawn by the lines of force. From this simple construction already shown you, we may proceed to wind a large number of conductors upon the iron core, so that the limit to which the effect may be increased will depend upon the limit imposed upon us by the space in which the wire may be wound.

Experience has developed numerous forms of armature, although but two of these forms have come into general use.

The drum armature for two-pole motors is represented in Figure 12. This cut is intended to show one method of winding the armature. A

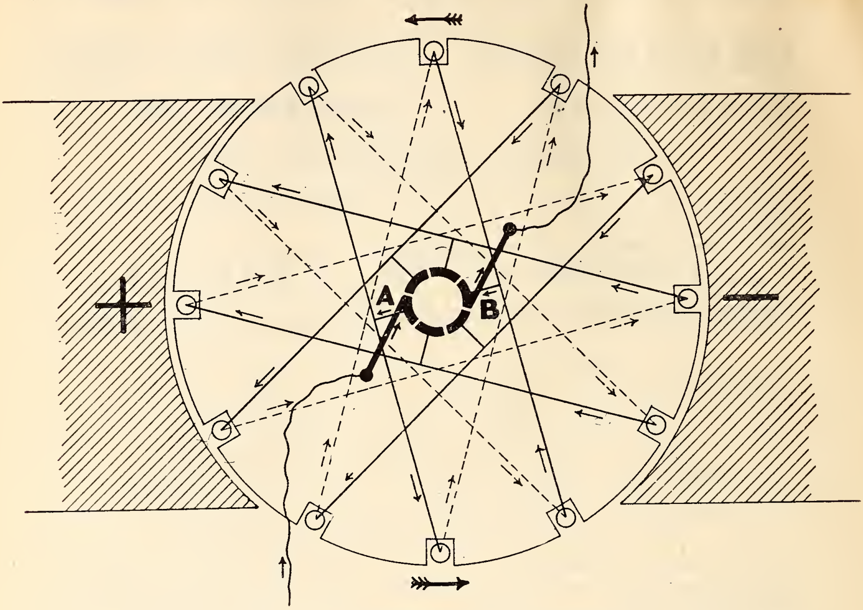

Fig. 12. Drum Armature for Two-Pole Motor.

commutator with six sections is used with this winding, one section being connected to each wire represented in full lines where it crosses the end of the drum. As the insulated segments of the commutator are moved by the rotation of the armature, the brushes A and B will make a sliding contact with the armature wires. By tracing out the path of the current through the armature winding, it is found that the current flows in one direction in all of the wires in one air gap and in the opposite direction in the wires in the opposite air gap. This occurs in every phase of the revolution of the armature. The result is that the action of the current in all of the wires of the armature is to give a tangential pull in the same direction, which results in a rapid rotation of the armature.

Figure 13 shows a ring armature, a type in very general use. The winding is placed on this armature in a continuous coil. It will be seen that the flow of current between brushes occurs in one direction through one field, and in the opposite direction in the other field. The lines of force from the positive to the negative poles of the magnet cross the gap from the positive pole, and follow the metal of the ring in both directions around the centre of the armature, and then cross the gap into

the negative pole and then return to the positive pole through the iron casing not here shown. The winding of the ring armature is much

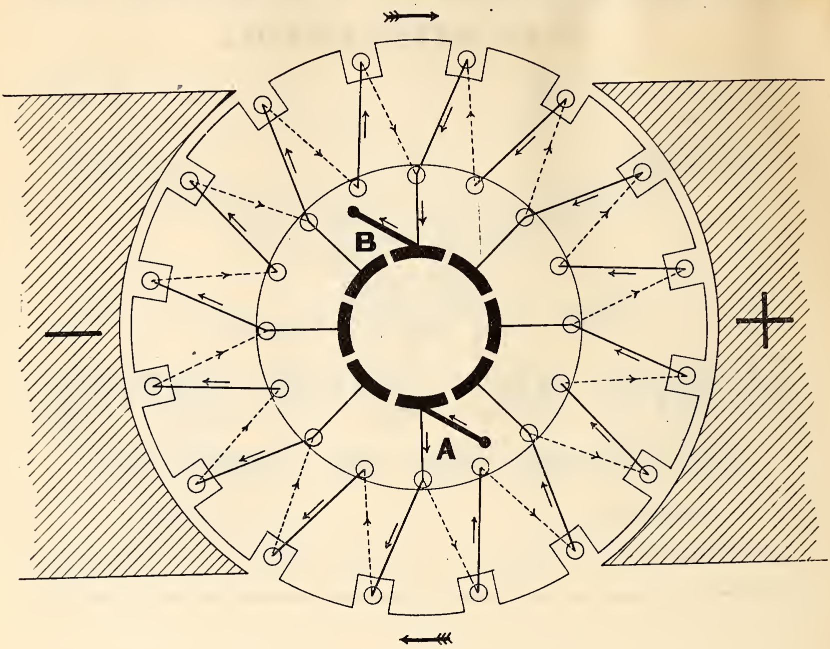

Fig. 13. Ring Armature for Two-Pole Motor.

simpler than that of the drum on account of the windings of the drum overlapping each other in a manner that makes the drum difficult to repair in case of a burn out of any of its sections. It will be observed that the active portions of the wire on any armature are only the portions that cut through lines of force of the field magnet, while the wire at the ends of the drum and the wire in the centre of the ring armature are dead wires, and do not have the slightest effect in producing rotation. These wires are, however, necessary to connect the active portions of the wire in series so that the current through the active portions will always be in the proper direction.

All wires do not act with the same force, because the pull on the wire at any time depends upon the rate at which it cuts lines of force at that time; and it must be clear that when the wire is entering or emerging from the field of force, and hence is passing more nearly parallel to the direction of the lines of force, it is cutting a less number of lines, and hence the pull upon this particular wire tending to produce rotation is at its minimum.

In the construction of the iron core for the armature, we have hereto-

fore simply indicated that the presence of iron in this core is necessary to act as a bridge to conduct the lines of force between the gaps in the magnetic circuit, and that for purely mechanical reasons it was necessary that the iron core be supported and rotated on the shaft which carries the wire loops. In addition to the objection to rotating a heavy mass of iron, we find a number of other objections arising from the rotation of iron in a field of force. These arise from certain reactions which take place within the mass of the iron, due to the fact, first, that the polarity of this iron core must change with the rotation, and, second, reactions are set up between the wire loops surrounding the mass of iron and the iron itself. Some of these difficulties give rise to certain modifications which it is necessary to make in the construction of the iron core. Since the face of the iron core which is near the positive pole of our magnet is magnetized negatively, and the opposite face which is adjacent to the negative pole of the charged magnet is magnetized positively, and this position of poles is maintained notwithstanding the rotation of the iron core, it is evident that each part of the rotating disc must be magnetized alternately positive and negative, and that, too, in very quick succession; that is to say, two alternations in polarity from positive to negative or negative to positive must be made for each revolution of the iron core. This means that if the armature revolves 800 revolutions per minute, 1,600 alternations will be made in the magnetism of each part of the iron core per minute. We find, then, that a given part of our current is wasted in magnetizing and demagnetizing this iron core, or in supplying what are known as losses by hysteresis. But this is not all. It is apparent that if this core is made of solid iron and it revolves in a field of force, electric currents will be generated within the solid mass of iron the same as are generated within the copper wires which move across the field of force. These currents in the armature are known as eddy currents. As heating of the iron core results from the generation of these currents, and as quite a percentage of the power of the motor is consumed in driving the armature while the eddy currents are being generated, a construction was long ago adopted to prevent, as far as possible, the generation of these currents. I refer to the construction in which the iron core is built up of thin sheets of iron which are insulated from each other. As the eddy currents are generated across the face of the rotating armature and parallel to the wire attached to the armature face, the eddy currents can be largely prevented by making the mass of iron a non-conductor of electricity in the direction in which these currents flow. It is also evident that as the sheet iron discs rotate in the plane of the discs, the magnetic lines of force will travel edgewise through them without being obstructed by the insulation between the metal discs themselves. In this way the difficulty from eddy currents

and the heating of the armature from this cause has been very largely removed. Methods of ventilating the iron core to remove such heat as is generated in it are provided by the best makers of motors.

There is another improvement in the iron core to which I will briefly call your attention. The plan of winding wire upon the face of the iron core, which is built up of laminated discs, meets with some difficulty, as the pull which causes rotation of the armature is between the lines of force and the wire conductors upon the face of the armature. The tendency would therefore be to strip the wires from their fastenings upon the armature. A modern construction adopted largely in street car motors is to provide grooves in the face of the armature parallel to its length. In these grooves the wire winding is placed below the surface of the iron cylinder. This forms the whole surface into what resembles teeth, the wire being wound between the teeth. As a support and protection for the wire the toothed armature is, therefore, of advantage. It however has another advantage of importance. It will be apparent that when an armature is built in this way, the width of the air gap between the armature and the field magnet will be very much reduced. The result is, that with a given excitation in the field coil a very much larger number of lines of force will be produced, and hence a much stronger pull upon the armature to produce rotation is obtained.

I desire briefly to call your attention to one of the reactions which takes place between the iron core of the armature and the current which passes through the wire winding of this same armature. I have already called your attention to the fact that in all constructions of armatures the current flows in one direction through all the armature wires in one field and in the opposite direction through all the armature wires in the other field. The effect of the electric current flowing around an iron core in the direction here indicated is to establish poles in parts of the armature core differing from the poles which are induced by the field magnets. The result is that the combined effect of a current through the windings of the armature in producing one set of poles and the effect of the field magnets in producing a different set of poles is a shifting of the actual polarity of the armature to a position not agreeing with either set of poles taken separately. The amount of this shifting in either direction depends upon the relative strength of the two magnetizing forces tending to produce poles in different places. In order to have the commutator brushes at the top and bottom, or in positions where there is no lead, it is important that the predominating influence in determining the polarity of the armature should be the field magnets. For this reason it is desirable that the effect of the field magnets be made as strong as possible and that the motor be proportioned so as to give the field magnets the controlling influence in the formation of poles.

By using care in designing motors in this respect, the line of commutation, or the line joining the point where brushes make contact with the commutator, may be perpendicular to the line joining the centre of the pole faces, so that the motor may be run in either direction without shifting the commutator brushes. In other words, the motor may be run without a back lead to its brushes and at the same time without injurious sparking to its commutator. This is important in street railway work as it removes the necessity for shifting the position of the commutator brushes whenever the motor is reversed.

In recent years many of the high power motors used in railway work

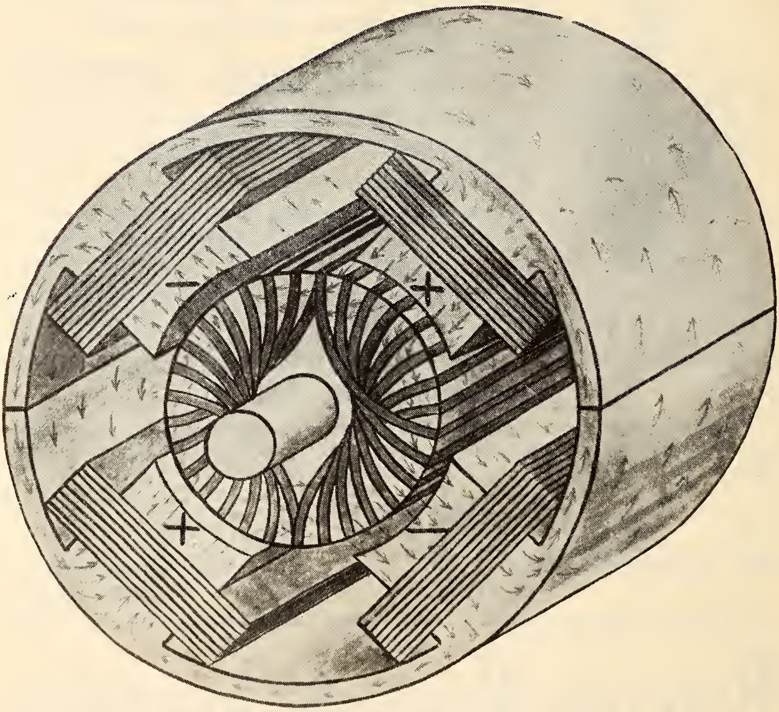

Fig. 14. Diagram representing General Features of Four-Pole Motor.

are of the multipolar type. Figure 14 represents the more common construction of the four-pole motor. It will be noted that opposite poles are alike. The lines of force pass into the armature from the positive poles and then divide in the armature and pass in both directions and into the adjacent negative poles from which the lines return

back through the casing of the motor, not shown in the cuts, to the positive poles. This construction has the advantage of short magnetic circuits and is capable of being worked into motors of immense power.

Different methods of winding may be used with these armatures, but

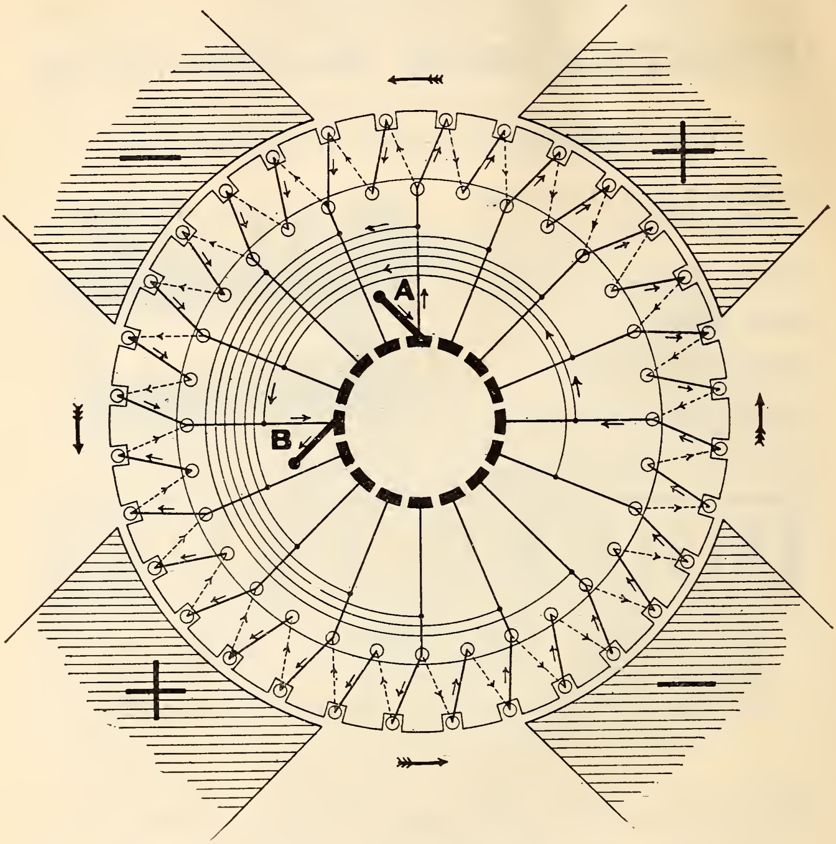

FIG. 15. Winding of Ring Armature Cross Connected.

Figures 15 and 16 show diagrams of windings and connections more commonly used. Figure 15 shows the winding of the ring armature in which the connections to the cómmutator are cross connected by the circular wires. It is necessary to use only two brushes, which stand at an angle of ninety degrees from each other. Figure 16 shows the winding for a drum armature which is not cross connected, and hence four brushes are used. The current enters at opposite brushes and leaves the armature at the intermediate brushes.

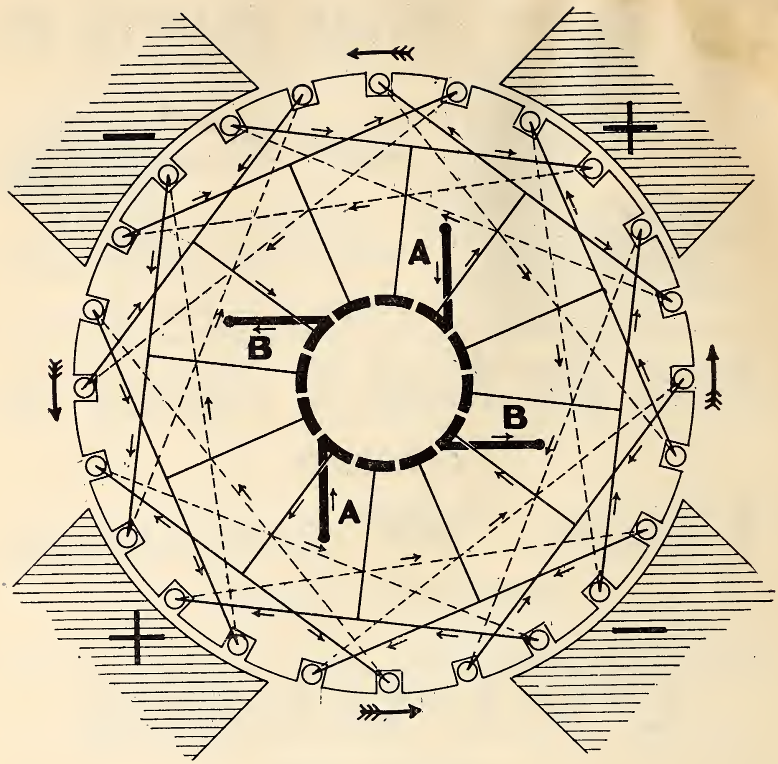

Fig. 16. Winding for Drum Armature.

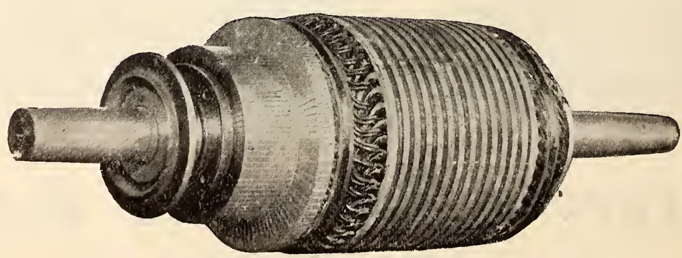

Fig. 17. Armature of the Westinghouse No. 12A Motor.

Figure 17 shows the armature of the No. 12A motor made by the Westinghouse Electric and Manufacturing Company. This armature is of the drum type and is used with a four-pole field.

The armature may be seen in position in the motor in Figure 18.

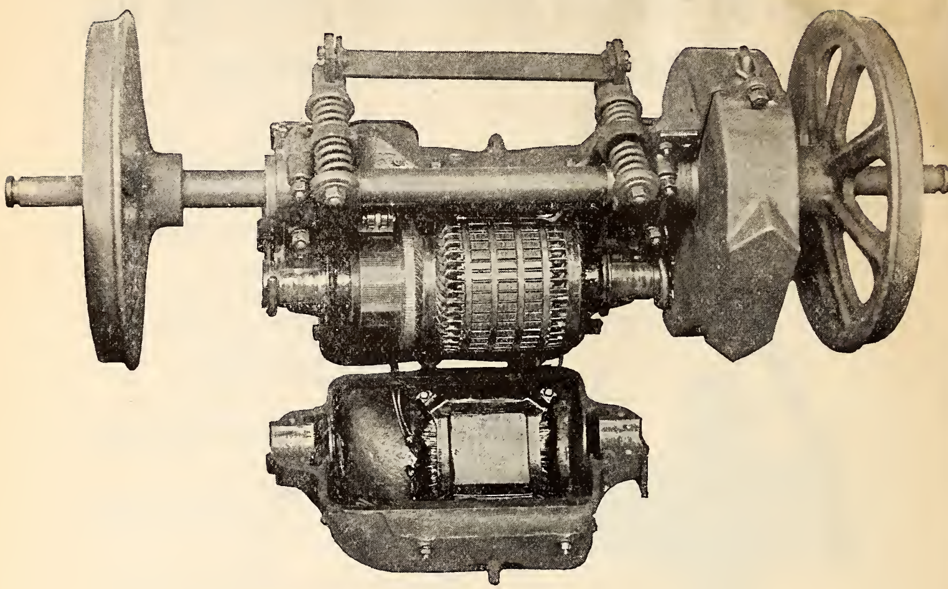

Fig. 18. Westinghouse Fifty H. P. Motor No. 38 with Lower Field opened down.

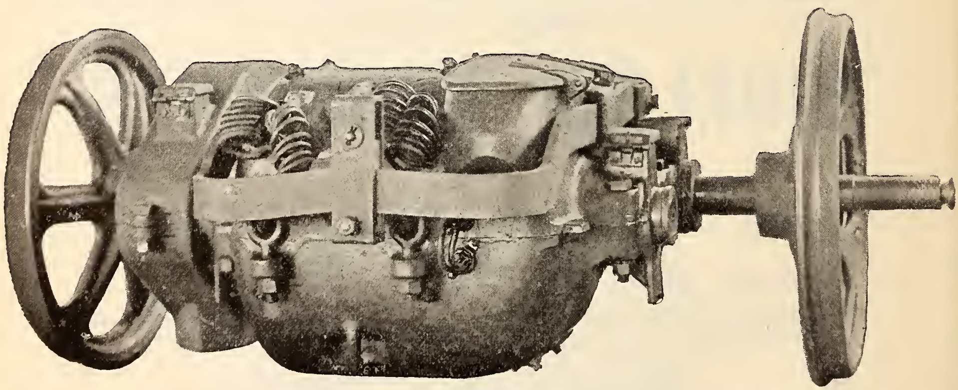

Fig. 19. Westinghouse Fifty H. P. Motor No. 38 mounted on Car Axle.

It will be understood that two fields are placed in the lower casting, and are brought into working relation to the armature by closing the motor. This armature has 768 conductors across its face, which give it a powerful torque or turning movement. This motor, I believe, was one of the earliest single-reduction motors used in street car work.

The General Electric Company motor G. E. 800 is represented in Figure 20. This is the type of motor used by the General Electric

GENERAL ELECTRIC COMPANY

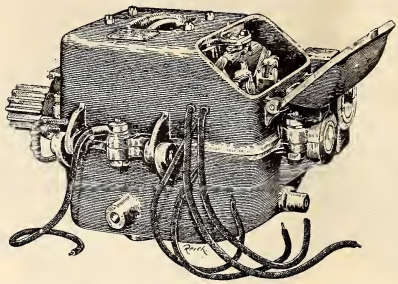

FIG. 20. General Electric Motor G. E. 800.

Company for street car work. Figure 21 represents the large motor manufactured by the General Electric Company. This motor is used

GENERAL ELECTRIC COMPANY

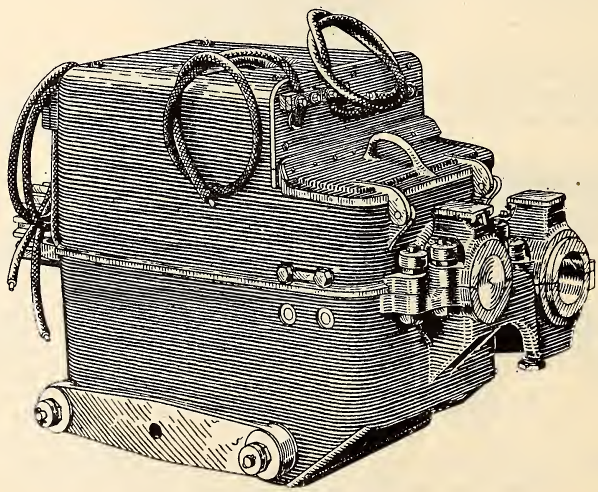

FIG. 21. General Electric Motor G. E. 2000.

for drawing the elevated trains on the Metropolitan Railroad of Chicago and other roads. Its armature is represented in the middle cut of Figure 22 which indicates the method of building up the armature. The brush-holder is represented in the upper cut of Figure 22 and the commutator is shown in the lower cut. An idea of the substantial character of the construction of the parts of this motor may be obtained from these figures. Figure 23 gives a section through this motor, from which an idea of its parts may be obtained. I believe its

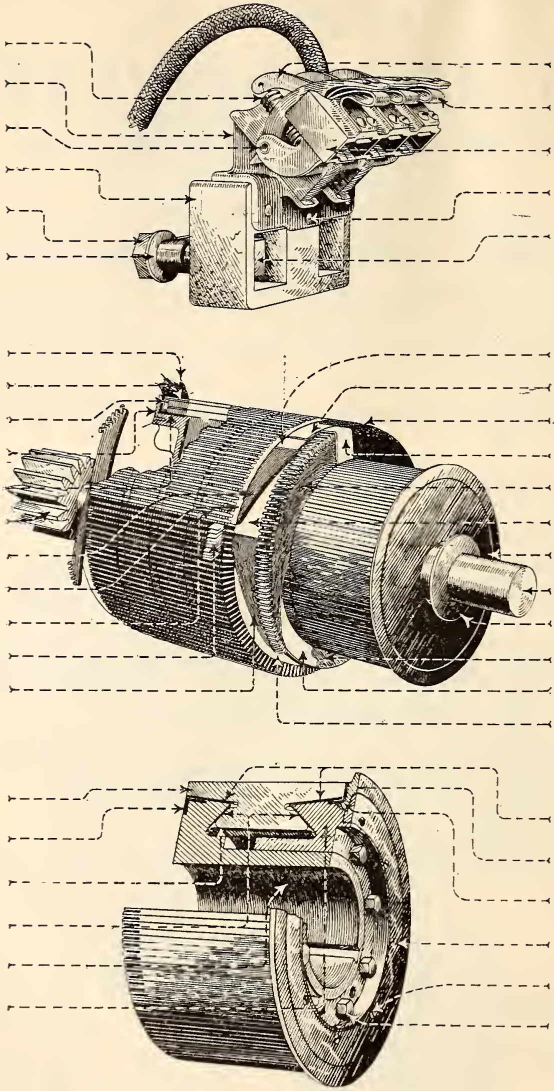

FIG. 22. Brush Holder, Armature and Commutator of Motor G. E. 2000.

name, G. E. 2000, indicates that the motor will give a drawbar pull of 2,000 pounds. Like the motor already referred to, this motor is of the four-pole type and has with it many points in common. In both of these motors the field of force is made

large, the air gaps are made small, and the length of the magnetic circuit is made as short and compact as possible. The casing is designed to offer a water-proof protection to the motor and at the same time to furnish a path by which the lines of force may thread their way from the negative to the positive pole of the field. It also furnishes a strong frame-work by which the armature and its pinion are held in working relation to the gear wheel on the car axle, and at the same time it is so constructed that the armature can be easily removed and the different

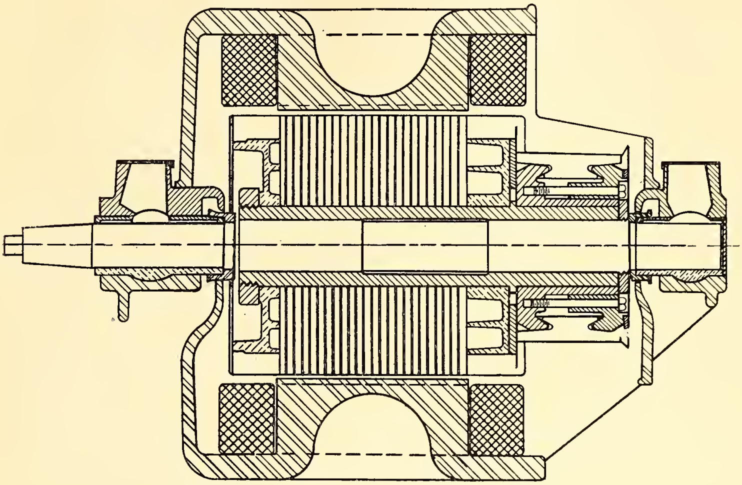

Fig. 23. Sectional View of Motor G. E. 2000.

parts of the motor inspected. As to the armatures, they are made capable of carrying a large current without injurious heating. The winding is placed in grooves across the face of the armatures and is carefully insulated. A comparatively small air gap is used and at the same time care is taken to avoid the possibility of the armature striking the field. By the lamination and ventilation of the armature serious troubles from heating are prevented, and the methods of winding give a large proportion of active to dead wire. The commutators are made of a large number of sections, and the motors run with little or no sparking. I believe that these motors represent the highest skill in the art of motor designing.

I will say in conclusion that the modern electric motor, in its electrical and mechanical development, and in its application to large railway systems such as you have in this city of Boston, is, to my mind, the greatest product of the nineteenth century. What its future will be it is difficult to say, but we can safely predict for it a larger and more extended use in performing the world's work.

The President. We have with us Mr. L. H. Parker, of the General Electric Company, whom I now have the pleasure of introducing to you.

ADDRESS OF MR. L. H. PARKER.

Mr. President and Gentlemen of the New England Club : — It gives me great pleasure to be with you to-night, and to be able to read a paper concerning the installation of the electric locomotives in the Belt Line Tunnel of the Baltimore & Ohio Railroad Company, prepared by my friend Dr. Louis Duncan, President of the American Institute of Electrical Engineers and Professor at Johns Hopkins University. Dr. Duncan writes as follows : —

PAPER BY DR. LOUIS DUNCAN,

Electrician, Baltimore & Ohio R.R.

The electrical equipment of the Belt Line Tunnel of the Baltimore & Ohio Railroad is a distinct advance in the type of electrical equipment which it represents, and it is also a distinct departure from the ordinary course of electrical development.

The advantages which electricity offers, as compared with steam, for ordinary transportation work consists in the possibility of running a number of trains at short intervals, at high speed, and with great economy. It has grown from the ordinary tram-way in towns and cities, to lines connecting towns and cities, and is beginning to be used for freight as well as passenger service. In every case, however, its growth is in the direction of frequent service and small trains.

In the work required by the Baltimore & Ohio, however, it was not any of the ordinary advantages that attracted the officials of the road, but the incidental advantage that it was smokeless and would allow the operation of the Belt Line Tunnel without any provision for ventilation. This tunnel extends from the present Camden Passenger Station of the Baltimore & Ohio Railroad about 7,000 feet through the city, and beyond this there are a succession of cuts and short tunnels for four or five miles. The main tunnel has for the greater part of its length a grade of eight tenths of one per cent, and passing as it does directly through the middle of the city, any plant for ventilation would have been seriously objected to by people living in the vicinity of the route. The heavy freight trains which pass through it require two locomotives on the grades, and this would fill the tunnel with smoke to such an extent that passenger traffic would be seriously interferred with.

Before the tunnel was used for passenger service, and before the electrical equipment was completed, freight trains were run through;

but the result was that several men were asphyxiated, and so when passenger traffic began, the freight trains were sent across the Patapsco River on the ferry that was formerly employed for the total service, and it was not until the electrical equipment was in operation that they were sent through the tunnel.

When the plans were first considered, the maximum service that would ever be required in the tunnel was calculated, and the plant was contracted for on that basis. The electrical equipment was to extend over about three miles of road, and there were to be enough locomotives and sufficient power in the power house to haul at the same time a passenger and a freight train up the heaviest grade. This contract was let to the General Electric Company, and they have carried it out, in spite of the fact that many difficulties were met with for the first time, with industry, intelligence and success.

Before it was finally concluded to adopt electricity, calculations were made on several other plans, but it was determined that they would not operate successfully. Compressed air was considered, and a cable plant was also taken into consideration. It was determined, however, that electricity presented advantages which neither of the other schemes possessed, and its adoption and successful operation has shown the wisdom of the conclusion reached by the officials of the Railroad Company.

Briefly, the main features of the plant are as follows: —

In the boiler room there are six batteries of boilers, each consisting of two 250 h. p. Root boilers; Deane pumps; and a 3,000 h. p. Webster Feed Water Heater. The Hawkins Mechanical Draft System is adapted to operate in connection with the sixty-foot iron stack. This fan is governed by an automatic regulator, the speed of the fan depending upon the load on the generators. At an early date, mechanical stokers and conveyors will be added to complete this part of the plant.

In the engine room we have two distinct plants, — one for power and the other for lighting. The power plant consists of four Allis-Corliss engines, each rated at 600 h. p. at 110 revolutions, and to each of which is direct connected a ten-pole 500 K. W. General Electric Generator, the armatures being overhung on the sixteen-inch engine shaft.

The piping of the entire plant, for both lighting and power, is duplex throughout.

The lighting plant consists of four Armington & Sims 250 h. p. engines, two of which are belted to two 120 K. W. General Electric alternators, the other two driving eight Thomson-Houston fifty-light arc machines which are belted in tandem. The switch-boards of both the power and lighting plants are fitted with the ordinary equipments. The power house is provided with a twenty-five ton travelling crane.

Thus it is seen that there is nothing radically new in the equipment of the power house, but the novelty of the whole scheme lies in the immense weight and power of the locomotives, and in the construction of and method of taking the current from the trolley. This latter was indeed a very serious problem, as the current demanded would sometimes be as high as 3,000 amperes, and the success of the scheme adopted by the General Electric Company was doubted by many, even after several successful trips had been made.

The overhead conductor consists, briefly, of a trough made of Z bars rivetted together by a cover plate, leaving a small slot below through which a trolley arm drags two sliding brass shoes. In the tunnel this trough is suspended from bolts cemented in the arch of the brick work, and outside from a catenary construction, and is insulated with porcelain conical insulators, — the insulators being suspended by a bolt through their centre, and the trough being suspended from the insulators by iron castings which fit around them. This trough is in thirty-foot sections, and the joints are bonded with "Chicago" bonds. The entire overhead construction presents a very novel appearance, looking very similar to a light suspension bridge construction.

The locomotives, two of which have been delivered to the Baltimore & Ohio Company, the third remaining to be delivered, are each mounted upon two trucks and equipped with four six-pole motors which are direct coupled. The armature shaft is a sleeve slid over the truck axle and held apart from it by means of springs, — thus the blows that the track would receive from these immensely heavy motors are deadened. These locomotives are made in two parts, the bodies over the trucks being made entirely separate, but coupled together. Each machine is equipped with an enormous controller for handling the heavy currents that are used; Westinghouse air brake; air whistle, and an automatic electric pump for charging the air reservoir. The trolley arm is a sawbuck arrangement of wood which adapts itself to any rise or dip in the conductor, and can be deflected at any angle. These machines are capable of attaining very high speed, and have given ample proof of their ability to haul the heaviest freight trains. In one particular instance, a train weighing 1,900 tons was taken through the tunnel and stopped upon the eight tenths per cent grade, due to a slight accident to one of the couplings. This being righted, the train was again accelerated with a rapidity such that the estimated drawbar pull was about 60,000 lbs.

The most serious difficulty that was encountered during the early service of the first locomotive, was the very heavy sparking of the trolley shoe. This was due to the fact that the overhead structure was erected some time before the first locomotive was delivered, and became coated

on the inside with rust; and in the tunnel, where it is especially damp, the rust was so heavy that when a cleaning shoe was dragged through, large flakes of oxidized iron were swept out. This difficulty was finally overcome by scraping with steel brushes, and by a liberal application of coal oil and a mixture of oil and plumbago. The sparking is practically nothing now, and it is only necessary to run the cleaner through about once in three weeks.

There are three out-going copper feeders carried upon the same suspension as the conductor, each being a 1,000,000 c.m. stranded cable, making the conductivity of the overhead line about equivalent to 5,000,000 c.m. The track is double bonded with No. 0004 "Chicago" bonds, and these bonds are cross connected to a 1,000,000 c.m. cable which is laid in a trough between the two tracks. This return circuit, as shown by recent tests, is about equivalent to 5,000,000 c.m. of copper; the two tracks being laid with eighty-five pound rails which contain a high percentage of carbon.

The smallness of the leakage in this overhead construction has exceeded all expectations, especially as the tunnel is exceedingly damp, moisture constantly condensing upon the structure, and there being a constant drip upon certain portions of the work, through the brick arch of the tunnel. The working voltage on the line is about 650 volts.

The following is the service given by the motor for the month of December, 1895.

Total No. of days,	31
Total No. of trains,	365
Total No. of cars,	8,755
Average time per train,	10 min.
Average No. of cars per train,	24
Average No. of trains per day,	12
Average amperes per train,	985.1
Average amperes per car,	41
Average voltage,	675
Average h. p. per train,	891
K. W. hours,	40,446

Perhaps you would like to know something of how we found the measure of what the locomotives could pull. We knew they would pull considerably, for we found by turning on the "juice" or current too suddenly we would generally jerk out a drawhead or break some coupling pins or links. For a short while after we had started the regular service, we had considerable trouble in this respect.

We electrical people attributed it, of course, to the poor quality of the drawbars, etc.; but after awhile we learned how to apply the power, and

how to start a long freight train. We find there is quite a knack in starting a train, as a great many of you gentlemen can testify, no doubt. But I can say we have now mastered it, and the locomotive operators have now no trouble whatever in bringing a train up to speed from a standstill. In fact, these operators, who were old steam enginemen, say they can accelerate a train without jerks better with the electric locomotive. The starts are made on a down grade of six tenths of one per cent, leading to the south portal of the tunnel; after the tunnel is reached the train commences to ascend an up grade of eight tenths of one per cent, which continues through the tunnel. We obtained the Pennsylvania Railroad dynamometer car to measure our pulling capacity. The most the car would record was 26,000 lbs. drawbar pull. As the electric locomotive we knew would pull considerably more than this, we were obliged to select a light train. We coupled the dynamometer car between the locomotive and a train consisting of about twenty-two cars, which we estimated would give us a drawbar pull of in the neighborhood of 25,000 lbs. This train was then pulled through the tunnel and careful observations were made of the current and the voltage, and the speed and horizontal effort. All of these factors were automatically recorded on the dynamometer car diagram. The results obtained in the first trip were, first, the total drawbar pull for a certain weight of train, from which we calculated directly the drawbar pull per ton of train on the .8% grade. This we found to be 22+lbs. After subtracting the grade pull, which for an .8% grade is sixteen pounds per ton, we have the difference 6 + lbs. as the train resistance per ton. This, you will note, confirms the D. K. Clark's and other authorities' figures for freight train resistance. Now, we had measured also the current taken to pull this train, but it included the current required to drive the locomotive. We wanted some means of separating these amounts and thus get the actual current required to give the net drawbar pull. In order to do this we switched off six cars of the original train and then drew the smaller train through the tunnel behind the dynamometer car and the locomotive under precisely the same conditions as we had the first train. We then had another set of readings for current and drawbar pull. Now, it is plain to see that the difference in the current taken for the first train and the second train would be the current required to draw the six cars switched off; also the difference in the drawbar pulls in the two trains would be the drawbar pull required to draw the six cars switched off. It is evident, therefore, that we could get from these differences of drawbar pulls and currents the amount of drawbar pull that one ampere would exert. You see we had eliminated the locomotive. The drawbar pull per ampere we found was twenty-eight and six tenths pounds. Now, to get the amount of current it would take to pull the locomotive was a

simple matter. We took either the records of the first train or the second train and observed what the drawbar pull was; dividing it by twenty-eight and six tenths represents the current used to give this drawbar pull. Then, noting the entire current actually recorded by the instrument in the locomotive, and subtracting from it the current above calculated, the difference would be the current required to drive the locomotive alone. It is very evident, therefore, that all we have to do now at any time to determine how much drawbar pull we are exerting or the weight of the train we are pulling is to simply read the current on the ampere meter in the locomotive, and after subtracting one hundred and forty-four (which is the current required to drive the locomotive alone) multiply the remainder by twenty-eight and six tenths, which gives us directly the drawbar pull. As I have said before, the operators of the locomotives are old B. & O. enginemen, and they have become quite expert in the handling of these machines. It was thought at first that it might be necessary to have an electrician on the locomotive continually; but it is very gratifying to state that the operators are their own electricians, and they are able to handle the locomotive in every way as regards its operation. They are becoming more familiar daily with its simple mechanism, and are fully able to keep the machine in first-class condition themselves.

The current indicator or ammeter referred to is a very good thing for them in the operation, as, by it, they can see exactly the character of the train and of the track, and are able to instantly note the increase of pull as they open the throttle; and, consequently, they are not so liable to slip their wheels as on a steam locomotive.

We decided to measure the acceleration; that is, how fast could we bring a train of nine or twelve hundred tons up to a speed of twelve or fifteen miles an hour. We decided that if we could record the distance travelled in each interval of two seconds, commencing from the start and then laying these distances out as ordinates, we would get a curve showing the acceleration of the train. It was necessary, therefore, to have some means of marking our position in the tunnel at the end of each interval of two seconds. It was first suggested to hitch a white string at the starting point and at the end of the interval of two seconds by a stop watch, some one would touch the string with a red ink brush. This was tried, but was unsatisfactory. The next suggestion was to make a mark on the track, but the tunnel has a rock-ballasted track which is dirty and dark colored from oil and dirt, and as the light in the tunnel is not of the best, it was necessary, therefore, to have a marker that was light colored and thus easily found afterward. Some one suggested using a handful of flour. We bought some flour and tried it. It worked very well for low speeds, but would become blown away when we were

going sixteen feet and over a second. Having the flour, and water close at hand, the next step was to make the flour into dough balls, which answered the purpose very satisfactory. They were light colored, would not bound out of place where dropped, and were very easily found. It may seem curious to you that we did not have some regular instrument for recording distances travelled, such as is used in laboratories; but, as the locomotives were in regular service, we were unable to do other than make impromptu tests at that time and use what means we had at hand. However, I think you will agree with me that the means we did use, while unusual, gave us very accurate results, and were certainly cheap and accessible at all times. From the observations made we found that we could accelerate a 985-ton train up to a speed of sixteen feet a second, or about twelve miles an hour, in a period of one minute. I doubt if a steam locomotive of equal weight could equal this performance.

We have exerted over 60,000 lbs. drawbar pull even on the track in the tunnel, which at times is very damp and greasy. We have made a speed running light of sixty-one miles an hour on an up grade. On a level this would mean seventy or eighty. With a three or four hundred ton passenger train we are able to make forty to forty-five miles. As our locomotive weights ninty-seven tons or 194,000 lbs., you see we are getting a drawbar pull of about one third of our total weight, which is the adhesive weight. The locomotive is operated very similarly to a steam locomotive, and the means of turning on the current is a lever on No. 2 locomotive; it is like the throttle of a steam locomotive. As I have said, we found that the train resistance was about six pounds per ton. This was determined last September on a very warm day. We find that the trains pull heavier in the winter months, and we approximate the train resistance to be twenty-five per cent greater now than it was during the summer.

This is undoubtedly due to the increased journal friction; that is, the lubricants become thickened from cold.

There is a good deal more to talk about, but I am afraid I am taking others' time. I thank you for you kind attention.

Mr. Marden. I would like to ask Mr. Parker one question, if I may be allowed. I would like to ask if his company have made any progress toward applying electricity to steam roads generally, and, if so, whether they have got so for as to tell about how far apart installations would have to be made to furnish power, and what per cent of loss there would be; and whether it would be practical or not, either in suburban traffic or on a long line service.

Mr. Parker. Well, that is a matter we are all figuring on at present. There is no difficulty in deciding the most economical methods of

transmission of the power for any locality after you have once looked over the ground, determined the nature and amount of your service, and figured what it would cost to produce power at your central station or stations. If it is a rather infrequent service with a heavy train the problem would need to be carefully considered, for those are the worst conditions for electricity as a motive power. But when you consider interurban and suburban service, where you have a great number of trains at frequent intervals, as you have on a great many roads entering this city, the conditions are especially favorable for the adoption of electricity. We have almost perfect dynamos with efficiencies of ninety-eight and ninety-nine per cent. We have very efficient slow speed stationary engines, our electric motors are to-day equally efficient machines, and the only problem to my mind that requires the greatest attention at present is that of getting the current into the moving train. On the Chicago West Side Elevated Road they use a third rail like that used on the Intramural road at the World's Fair. This may be applied to surface roads, and I believe that it is possible to place a third rail conductor either between the rails of the track or at the side of the track that is an efficient and practical substitute for the overhead trolley. There are a great many sides to the question, but I believe the day is close at hand when this important problem will be solved. From the experience on the Nantasket road, which many of you have seen, we can travel sixty to seventy miles an hour using the overhead trolley wire. This would be all right if it were not for the poles and the unsightly overhead construction. Some people might consider that a third rail exposed between the rails of the track might be dangerous; but it is perfectly plain that if a low voltage is used and ordinary precautions taken, no danger need be anticipated.

Regarding leakage from an exposed conductor if it should be submerged in water or snow, I am pleased to cite the case of the Metropolitan Railroad Company, of Washington. Mr. Connett, their engineer, informs me that they have had their conduit filled with water and with the water standing two or three inches over the tracks. You of course know that they use exposed iron conductors suspended on insulators in a regular cable road conduit. By putting what is known as a water rheostat in series with his submerged sections at the power house he was readily able to control the leakage. While the cars would go a little slower while running on these sections it is pleasing to know that they would run at all. There are four or five means of distributing the current from the power station. For ordinary distances the ordinary two-wire system, such as used on street railway work in general, is the simplest. For longer distances, in order to save copper, what is known as a three-wire system may be adopted. By its means we are able to save

fifty per cent of the copper required to do the work of the two-wire system. There may be also used for these longer distance transmissions the "Booster System." That is, when the current is required at the distant points it is directed through an additional dynamo at the power station, which raises the pressure or voltage by an amount equal generally to the amount lost in overcoming the resistance of trolley wire and feeder. For very long distances, say thirty or forty miles, it is customary to use high voltage alternating currents and then transform them at the point where they are used into direct currents at low voltages.

Mr. SUTHERLAND. Just what proportion is required on the system in the matter of power as applied to the train?

Mr. PARKER. Do you want to know something about the comparative costs?

Mr. SUTHERLAND. No. The comparative power which is applied to the motion. The charging of the system, to haul trains.

Mr. PARKER. The only data that I have in mind at the present moment relating to the efficiency of steam locomotives is some relating to investigations made on French Railways, which were confirmed by similar tests on the Pennsylvania Railroad. If I remember correctly, it was stated that only forty-five to fifty per cent of the indicated horse power of the steam locomotive was delivered as effective drawbar pull. Now, taking in the efficiencies of our electric locomotive, the trolley line, the dynamos, and the engines, working under normal conditions, we get a resultant efficiency of the system between sixty and seventy per cent. If we should add more copper to the overhead line we would get still greater efficiency, but there is a limit to that; that is, when the cost of power lost in the line transmission is equal to the interest on the cost of copper used in the line, you have the most economical distribution of copper. The efficiency of our locomotive alone is in the neighborhood of eighty-five per cent. This was obtained from our dynamometer tests.

Mr. SUTHERLAND. Thank you. I have heard a good deal of discussion on the electric pull and about the relative proportion of the effective power, and that there was an efficiency as high as sixty per cent. Others said that it did not exceed thirty per cent, but the efficiency of sixty per cent is a good fair one.

Mr. PARKER. It may be interesting to you to know something of the costs of operating a locomotive.

Statement.— For the operation of the Baltimore & Ohio Tunnel Power House for the month of October, 1895, the itemized expenses were as follows:—

Labor	$1,345.70
Coal ($1.35 per ton)	400.96

Oil and waste	151.26	
Water	50.66	
Maintenance	25.42	
		$1,974.00

The expense on electric locomotives was,—

Motor engineers	$200.00	
Oil and waste	12.16	
		212.16
	Total expense,	$2,186.16

There were hauled through the tunnel 353 trains.

Average weight of each	1,095 tons
" time of trip	20 minutes
" amperes	986
Distance per trip	4 miles
Engine miles	1,412

Actual time consumed for above, 118 hours.
Idle time for month, 626 hours.

It is customary to consider an engine with steam up as equivalent to six engine miles for each hour it is idle.

For comparison; the actual mileage must be increased 6 x 626 = 3,756 miles.

The large charge, labor at power house, will be the same for one, two or three locomotives in service. The items, coal, water and maintenance and the expenses on locomotives increase with the number of locomotives in service. Assume this increase to be proportional.

The total expense and cost per mile are as follows :—

	Total cost.	Engine miles.	Cost per engine mile.
For one locomotive	$2,186.16	5,168	$0.423
" two locomotives	2,875.36	10,336	.278
" three "	3,564.56	15,504	.23

Thus you see if we have three locomotives doing the work that one did during last October, or if we gave the two now in service two or three times the work that they are doing, the cost per engine mile would be in the neighborhood of twenty cents. I have recently received some figures for freight locomotives on a prominent Eastern road, which is doing a monthly train mileage on the whole line of about 463,000 miles. The cost per engine mile, which includes repairs, fuel, oil, waste, engineers' and firemen's wages, and cleaning, is 21.93 cents for the month of September, 1895. Please bear in mind, however, that

such comparisons should not be considered other than based on the results obtained from a single isolated electric locomotive plant; and that when larger installations have been made, we will be able to obtain more complete and satisfactory comparisons. Comparing the results on the West Side Chicago Elevated, operated by electricity, with the Alley L, I know that the former operated for the past nine months for only forty per cent of their gross receipts, while the latter is paying for the expense of operation not less than eighty per cent of their gross receipts.

The President. We have with us a representative of the Westinghouse Electric Manufacturing Co., Mr. Calvert Townley, whom I now introduce to the Club.

ADDRESS OF MR. CALVERT TOWNLEY.

Mr. President and gentlemen, I won't take up a great deal of your time. I have here a report on an experimental road that has been installed by the Pennsylvania Railroad in New Jersey which perhaps will have some points of interest for you, and I will read them. It may perhaps be not out of place before doing so to make a brief statement of the principal features that have to be considered in applying electric traction to general steam railroad service. In doing that it will possibly be best to divide the subject into three divisions; namely, the generation of the power, the transmission of the power from the point of generation to the point of utilization, and the application of it.

Of course every one is familiar with the ordinary application of the electric motor to street car service, and how that has developed from the old days when they put two small motors on a car, seven and one half horse power each, to the present day when the ordinary cars have at least two motors that rate uniformly from twenty-five horse power each up, some of the larger ones being fifty horse power each. Now, the applicability of this type of motor to traction service has three particular characteristics. The first is, that in direct contradiction to what is true with the locomotive, the strongest power is exerted by the motor at its lowest speed. In other words, when you start your train and have to overcome the inertia of the heavy body, you get instantly the greatest exercise of power on the part of the motor. This would result, of course, when applied to steam railroad practice in making a start, or making all starts, more quickly than is possible with a steam locomotive of equal power. And second, it also means that it is possible to go up steeper grades with a given equipment of motor service, for the simple reason that at slow speeds you can get the maximum output of power. The third characteristic is that an electric motor will undertake to do all that the generator at the power station will

give it to do, and instead of getting stalled with a heavy overload, it will undertake to do more work than it was ever built to do, this characteristic being only limited by the capacity of the motor to withstand heat and not burn out or open the circuit by means of a safety device. In fact, it is customary to equip various street or steam roads with motors that are expected to be overloaded fifty per cent, or even seventy-five and sometimes one hundred per cent, of course it being understood that such heavy overloads will be only for short periods of time.

Now, it has been pretty clearly demonstrated within the last year or two that there is no reasonable limit to the amount of power that you can build an electric motor to generate. I do not see any reason for believing that it is not practicable to build electric locomotives fully as powerful as or in fact more powerful than any steam locomotives are to-day. For instance, that powerful electric locomotive at Baltimore which we have heard described to-night is one that can be called on for a very heavy drawbar pull. I believe that locomotive has pulled more than any of the steam locomotives on the B. & O. road. It seems, therefore, reasonable to believe that there is no difficulty in the way of securing all the power that you want from the electric motor, provided you can bring that power to the electric locomotive successfully; *i. e.* generate it, transmit it and apply it.

The question of transmitting the power is one that has very serious obstacles. For the ordinary application of electric power to street railway service the distances are comparatively short; but as soon as you begin to stretch out the distance and go over long lines, you come up against the fact, that unless you expend an enormous amount of money for conductors you are going to have a tremendous loss of energy, unless there is some very important modification from the ordinary street car equipment. If we could have a perfect electric conductor, we would be able to transmit electrical energy through it without any loss whatever, but unfortunately no such thing has been found to exist. Silver and copper come the nearest to this of any metals that we know of, their conductivities being very nearly equal. Of course silver is out of the question at once, and even copper on account of its expense is almost out of the question when you are to transmit over a long distance.

Now, to transmit a given number of amperes (the current unit) over a certain length of line means that there will be a loss of energy, due to the heating of that line, in direct proportion to the square of the number of amperes passing. At the same time, to transmit electrical energy in large amounts you have got to use either a large number of amperes or a very high pressure, as the energy in watts is the direct product of the

amperes by the volts. On account of the fact that loss of energy increases as the square of the number of amperes, you will see that such increase of your power as will be necessary for large locomotives immediately increases your losses very heavily. There is, therefore, a strong reason for using as high a pressure as you can, thereby being able to transmit a large amount of energy with but a small number of amperes, and consequently with smaller loss.

There seem to be practical limitations in the construction of the ordinary types of motors for traction purposes to the pressure commonly existing in street railway practice. That practice is nominally to use a pressure of 500 volts, which actually is run up to 550 and 600, and even beyond that. In some cases, particularly where there are rather longer distances to be covered, the pressure is sometimes run up to 700 or perhaps 800 volts; but even this pressure is much too low to permit of the economical transmission of large amounts of power over considerable distances, — and by considerable distances, I mean fifteen to twenty or twenty-five miles or more. If, therefore, we are going to apply electricity as the operative power extensively to steam roads, we have got to get some means of sending it over long distances without too heavy losses, and without putting too much money into conductors.

It is quite easy to produce currents of very high pressure, but there are difficulties in the way of bringing the pressure down to the pressures required by the motors and the devices used on cars, always assuming that the same character of current as that now used in street railway practice, namely, the "continuous" or "direct" current, is employed. If, on the contrary, we use a different current, a current similar in many respects to that used for incandescent lighting by the Boston Electric Light Co., namely, an alternating current, it is possible to very easily generate currents of extremely high pressure and bring them down to working pressures by means of various types of transformers, and it seems to be along those lines that the long distance operation of steam roads by electricity has got to be developed; otherwise it will be necessary to have power stations very close together, and it is hardly probable that the investment of capital required would be warranted. There are at the present time available means of raising or lowering the pressure and transmitting considerable amounts of power over very long distances without the objections to which I have alluded, but as yet they have not been applied to the use of electric motors on long runs for roads operated by steam. It is, I think, highly probable that within the next year or two many of the difficulties in raising, transmitting and reducing large amounts of electrical energy to be applied to traction purposes will have been overcome by practical experience on different roads. It seems to be clear that the advantages of electric traction for,

accommodation trains over comparatively short distances, or for suburban service around large cities, and to a certain extent for the transportation of freight, are very marked. A quick start, freedom from smoke and cinders, the slight expense of additional locomotives for additional equipment, — all recommend it very highly. Then in the generating of the current there is an opportunity to make quite a marked saving in the cost of power over that on steam locomotives. You can, of course, install very much larger units of generating capacity, and use the highest grade of compound or triple expansion engines for reducing your coal consumption down to the lowest point, and it simply becomes then a question whether this saving is or is not more than offset by the losses of transmission and application. That is a question which it will be rather difficult to go into satisfactorily without examples to point to. But with that brief outline of the general features of applying the power, I will read this report which I have, and which touches principally on light passenger service at tolerably high speeds. I might say that this experimental road is a short road, seven and one third miles long, installed with one terminus at Mt. Holly, New Jersey, by the Pennsylvania Railroad last summer, and operated all through the summer. It was put in with the idea of determining how far the standard steam equipment of the Pennsylvania system could be adapted to the use of electricity.

At the time this letter was written there was still some work being carried on the road as will appear in the report.

The power house is located at Mount Holly, one of the end stations of the seven and one-third miles long road. It is a framework building lined with corrugated sheet-iron, and is built on piles which extend about ten feet above the swamp. The dimensions of the building are about 50 x 80 feet divided into two parts,— engine-room and boiler-room. The boiler is an Upright "Climax," guaranteed to evaporate 9,000 lbs. of water per hour without undue forcing. The feed apparatus used is one Worthington steam pump and a Korting injector. The water supply is taken from Ramco Co.'s creek.

The 225 K. W. eight-pole generator is direct-connected to a Westinghouse Compound Engine, guaranteed to develop 500 h.p. at a steam pressure of 150 lbs. and 250 revs. per minute.

On the marble switchboard is room provided for the necessary apparatus for four feeders and for the apparatus belonging to the generator. The machine panel has a double-pole switch, a double-pole circuit-breaker and an ammeter for 500 amperes. Each one of the feeders is provided with a single-pole switch, single-pole circuit-breaker and an ammeter for 500 amperes. The main panel is occupied by a station voltmeter and room is left for a main ammeter. All the instruments used are made by the Western Electrical Instrument Co., Newark, N.J.

THE TRACK AND THE OVERHEAD CONSTRUCTION.

The track is laid in 70-lb. rails and has common fish-plate joints, in addition to which "Chicago bonds" are used to secure proper contact between the different lengths of rail. To decrease the resistance of the rails a special No. 00 wire is used as extra return wire. This wire is soldered to all the Chicago bonds and extends across from one end of the road to the other.

The overhead construction is very much like that of a common trolley road. The two feed wires, of 500,000 c.m. area each, of which one is about five miles long and the other seven miles, are suspended on the wooden poles on one side of the track by means of special insulators.

The 00 trolley wire is soldered to ears which are screwed to insulating bells. These bells are twisted onto and kept in place by flexible iron span wires, stretched between wooden poles on both sides of the track.

Johnson insulators and ears are used. The feed wires tap into the trolley wires every 600 feet.

The cars, of which the trucks and the woodwork are manufactured by the Jackson & Sharp Co., Wilmington, Del., are forty-three feet long over all, and of the combined passenger-baggage pattern. The weight of a car fully equipped is 51,000 lbs., and it seats fifty passengers.

One car is equipped with four No. 38, 50 h.p. motors, and the two other ones have two No. 39, 75–100 h.p. each. Two cars are geared for a speed of forty-five miles per hour, and the third one for sixty miles per hour.

The controllers are of the series-parallel type. Each car has two trolleys, as the current used would be very heavy for one.

As the hand brakes would not give satisfactory results at the speed we run, the cars are equipped with Westinghouse automatic air brakes. The air compressor is run by an electric motor, which has an automatic starting and stopping device which starts the compressor when the pressure in the main reservoir is 70 lbs., and shuts it off again as soon as the pressure has reached 100 lbs. per square inch. The brake is controlled by an "engineer's valve" similar to the one used on steam locomotives; and in order to enable the motor man to control the working of the automatic device, double-handed air gauges, indicating the pressures in the bath reservoirs, are mounted above the engineer's valve.

A regular locomotive bell is used for the signals at crossings, etc., and a small gong gives the starting and stopping signals.

All the cars are equipped with controller at both ends, to run either way, like a street car.

Half the length of the road goes up grade and the other half down grade, the heaviest grade being eighty feet to a mile, and about three-fourths of a mile long.

The first car was started for experimental purposes on the 3rd of June this year, but the road did not open up for passenger traffic before the 22nd of July. The electric cars have only been used to carry passengers and baggage, the freight being handled by steam. During the fair week last month we often had an Adams Express car and our baggage-room in the motor cars completely full of baggage and accommodated the passengers besides, often having 2,000 of them a day. As the machinery in the power house is too weak for more we could only run two motor cars at a time. The highest speed attained at present with the electric cars was one mile in fifty-seven seconds, sixty-four miles an hour; but this was with a car geared for only forty-five miles and by special arrangement. Since that time they have run on test carefully timed at rate of one mile in fifty seconds, or seventy-two miles per hour.

I herewith enclose one of the records taken at a trial with car No. 1, which may give you an idea of the conditions under which we worked. Enclosed also please find a similar record for car No. 2. Both these cars are geared for forty-five miles per hour.

We generally use a voltage of 550 volts at no load, which gives us about 600 v. with 300 amp., the generator being over-compounded.

There was some trouble with the trolleys leaving the wire at the start; but modifications in the arrangement removed this difficulty, and they can be relied upon up to a speed of fifty miles per hour. At any higher speed some attention is necessary.

During all the time the road has been open for passenger traffic we have had absolutely no trouble on account of electrical or mechanical defects, only for late steam train connections, although the cars most of the time have been only temporarily rigged up.

We do not generally run more than one tram-car, a P. R.R. passenger car of 45,000 lbs. weight, but have occassionally run two, the one mentioned above and an Adams Express of 50,000 lbs. The speed reached with one trailer is about forty-five miles per hour, and with two trailers thirty-eight miles per hour.

The plans and specifications, etc., were composed by a consulting engineer in Philadelphia.

We run two motor cars at present, starting at 6.35 A.M. and stopping at 10.50 P.M. Each car makes nine round trips a day between Mt. Holly and Burlington, which is equal to 132 miles per day, and crew consisting of one motorman and one conductor. This gives a number of thirty-six trains a day on the branch.

I thank you very much for your attention. (*Applause.*)

Mr. Marden. Mr. President, I would like to ask one more question of the gentleman who has last spoken. I have noticed that in the trials that have been made the motors were applied either to all of the cars that were run, or else there would be one or two trailing cars. And more than that, Mr. Parker stated that starting a train at a slow speed would generate the greatest power. That I can readily see. The question I wanted to ask is whether a sufficient number of motors could be applied to an engine of sufficient weight to obtain a speed of from thirty-five to forty or more miles when they carry from six to eight or more passenger cars, practically, perhaps, of the same weight that we now run in our suburban trains, or whether it is going to be more practical to run trains oftener and lighter, or whether that will have to be done.

Mr. Townley. Mr. President, I will say that I do not think there is the slightest difficulty in making an electric locomotive give you practically any power at any speed that can be maintained on the track. Whether or not it will be cheapest and best to run trains following in the footsteps of the steam practice, using long trains and heavy locomotives, or whether it will be more economical to have them put into smaller and lighter trains with a greater number of locomotives, can only be determined by practice and keeping account of the expenses; but as far as any difficulties go in building large, powerful and swift electric locomotives, I don't think they exist. Have I answered your question?

Mr. Marden. Yes, sir.

The President. I will now call upon Prof. Allen, of the Massachusetts Institute of Technology, to say a few words upon this subject.

PROF. C. FRANK ALLEN.

Mr. President, electricity is not directly in my line, although, of course, its bearing upon railroad work makes it necessary for me to keep in touch with it to some extent. I have been very much interested, certainly, in what I have heard here to-night. I am very glad that so much interest is developed as is shown by the large number of members and others who are here to-night. I did not come prepared to say anything upon this subject, although I have had it in mind that the merit of electric traction as compared with steam traction for suburban service probably rested, at the present time, upon the fact that with the practicability of more frequent trains, so much better service would be given the patrons of the road that the receipts would undoubtedly be very much increased, whatever might be the absolute facts as to the cost, or rather as to the difference in cost, between electric traction and steam traction. Without having absolute facts to establish

it, my feeling has been very strong that there would not be a very material difference in cost between electric traction and steam traction; but there doubtless would be, in case the electric traction could be carried on with more frequent trains, a great increase of traffic, so that it might be to the advantage of the railroads to introduce it for that reason. The hour is late and I will not delay the Club any longer.

The PRESIDENT. We have with us Mr. Pierce, of the General Electric Co., who may have something to say of interest.

MR. CHAS. PIERCE.

Mr. President and members of the New England Railroad Club:— I wish to apologize myself for coming in here and representing the commercial end of an industry, and following the engineering talent that has gone before. I can illustrate my feelings by telling a little story. Probably you are familiar with it, as it is an old railroad story. The incident is said to have occurred in the Boston & Providence station some time ago, before the N. Y. & H. had the road. There was a man employed there whose duty was to announce trains. He had a rather serious impediment in his speech; and there was a lady and a little boy who came up to him, and she said,

"Will you excuse me, sir, but can you tell me what time the next train goes to Providence?"

"Well, the n-n-next t-t-train goes out at 10 o'clock."

She went away; she had some little time to wait, but in about ten minutes she came up again, and she said,

"I beg your pardon." She had the same little boy with her. "I wish you would kindly tell me what time the train goes to Providence."

"Why, I t-t-told you that the t-t-train w-w-went at 10 o'clock."

She went away again, and shortly afterward she returned and said,

"Would you kindly tell me, sir, what time that train goes?"

"Why, d-d-didn't I t-t-tell you two t-t-times that the t-t-train w-w-went at 10 o'clock?"

"I know that," she said, "but my little boy likes to see your mouth go." (*Prolonged laughter.*)

I have some such feeling in connection with being invited to speak here — like the fellow in Maine who was arrested for stealing and killing a sheep. His only apology was that no "Sheep could bite him and live." (*Renewed laughter.*) So having been invited to speak here, I can tell you I am bound to sustain the reputation that all electric men have, that whenever asked to speak they always accept.

But coming down to the matter seriously, I believe that we stand today emphatically prepared to give you gentlemen whatever you want. We can carry your weights further, better, safer by electricity than any

other known method in this world to-day. We can give you a tractive force stronger than anything you have juggled with, and I have pictures here which I want to pass round showing the principal features of the Baltimore & Ohio Co., — and I think this is as good a time to pass them round as any. I want to call your attention to the old road, and the differences between 1845 and the year 1895, as shown in one of the photographs.

We feel, also, that we can do this thing a great deal cheaper. There is no trouble about carrying on equally long distances to-day. Within the last ninety days, I think we have developed a system that we can safely recommend for long distances. It is rather experimental, to be sure, but we have means to do this work that would be satisfactory to you gentlemen.

As to the question of speed, I want to say that we can make speed. We think we can any way. I know that Mr. Sanborn thought our test at Nantasket beach gave good evidence of that. I asked him how fast we went. He said he thought he went 75 miles an hour. I asked him, "Didn't you go 85?" He said he wouldn't swear to it. I asked him if he didn't go 95. Well, then he did not know. There is no question, gentlemen, that we did go very fast there. We talked of 85 miles an hour. You can shade that a little, but probably we have gone 80 miles an hour down on the Nantasket beach road, with which you are all familiar.

I just wanted to say these few words for electricity, gentlemen, for the companies in the electrical field are willing to offer you this motive power in all ways that would be satisfactory to you as practical men. (*Applause.*)

The PRESIDENT. Are there any others who desire to say anything on this subject? Are there any questions to be asked? We have five minutes more.

Mr. MARDEN. I would move that a vote of thanks be extended to Mr. Parker, Mr. Townley, Mr. Pierce and Mr. McElroy for their valuable papers and the information which we have received from them.

(The motion was seconded and unanimously adopted.)

Mr. MARDEN. I would further add, and perhaps make a motion that we leave to the discretion of the Secretary as to how much or how many of the diagrams that have been exhibited to us to-night can be inserted in the next issue of our report, illustrating the lecture and papers that have been given us. I do not know as it would be practicable to do anything, but certainly some of the diagrams, both on the board and those that have been passed around, would contain very interesting information for us to have.

The PRESIDENT. I suppose those can be inserted in the report. Have you cuts of this diagram, Mr. McElroy?

Mr. McELROY. No, I have not.

The PRESIDENT. I suppose there could be cuts made of it, reduced and put into proper form, and inserted in the report which, of course, would go with the lecture for the refreshing of anybody's memory who heard the paper here to-night.

Mr. DESOE. Mr. President, I think that would be very important.

The PRESIDENT. I do not know as it would require any motion. It is simply for our Secretary to ascertain if he can get a copy, and have them inserted in our report.

Mr. MARDEN. I would move that the matter be left to the Secretary and the executive committee.

(The motion was seconded and carried.)

The meeting was then adjourned. 137 present.

NEW MEMBERS.

Allen, W. A., Chief Engineer Maine Central R.R., Portland, Me.
Calhoun, W. S., Agent Brussels Tapistry Co., Chauncey, N.Y.
Hobart, Nathaniel P., 39 Cortlandt St., New York City.
Hodgkins, W. W., B. & M. R.R. Co., Worcester, Mass.
Morrison, J. P., B. & M. R.R. Co., Boston, Mass.
Sears, Edward J., 70 Pearl Street, Boston, Mass.
Smith, Chas. D., N. Y., N. H. & H. R.R. Co., So. Boston, Mass.
Vickery, Chas. H., Car Dept., Fitchburg R.R., East Fitchburg, Mass.

CHANGE OF ADDRESS.

Fraser, Roland C., 120 Broadway, New York City.
Hogan, Sylvester, Cleveland City Forge & Iron Co., Cleveland, Ohio.
Woodward, Joseph T., West Sidney, Vt.

RESIGNED.

Barry, Robert, New York City.
Davis, Jas. A., Boston, Mass.
Davis, E. E., Reading, Pa.
Sherburne, F. S., Boston, Mass.

NEW ENGLAND RAILROAD CLUB.

ANNUAL MEETING

MARCH 10, 1896,

WITH

List of Members, List of Subjects 1890 to 1895, Constitution and By-Laws.

Published by the Club,

EDWARD L. JANES, SECRETARY, P. O. BOX 1158, BOSTON.

Next Meeting, Tuesday Evening, April 14, 1896.

OFFICERS FOR 1896-97.

PRESIDENT,
L. M. BUTLER,
Master Mechanic, N. Y., N. H. & H. R. R.

VICE-PRESIDENT,
J. MEDWAY,
Supt. Motive Power, Fitchburg R. R.

SECRETARY,
EDWARD L. JANES,
B. & A. R. R.

TREASURER,
CHARLES W. SHERBURNE.

FINANCE COMMITTEE.
L. M. BUTLER. F. E. BARNARD. GEO. H. WIGHTMAN.

EXECUTIVE COMMITTEE,

JOHN T. CHAMBERLAIN,
Master Car Builder, B. & M. R. R.

T. B. PURVES, JR.,
Master Mechanic, B. & A. R. R.

C. E. FULLER,
Supt. Motive Power, Central Vt. R. R.

HENRY BARTLETT,
Supt. Motive Power, B. & M. R. R.

F. D. ADAMS, President	March,	1883,	to March,	1885.
J. W. MARDEN, President	"	1885,	"	1887.
JAMES N. LAUDER, President	"	1887,	"	1889.
GEO. RICHARDS, President	"	1889,	"	1891.
FRED. M. TWOMBLY, President	"	1891,	"	1893.
JOHN T. CHAMBERLAIN, President	"	1893,	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Annual Meeting at Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, March 10, 1896.

The President, Mr. L. M. BUTLER, called the meeting to order shortly after 8 o'clock, and said : —

The first item of business before the Club is the approval of the minutes of the last meeting, and I will say that those minutes are not at hand to-night because our report is not printed. The printing of the report has been delayed on account of the cuts that had to be prepared to represent the electrical apparatus which was exhibited here at our last meeting. For that reason we shall have to pass that part of the business. The next thing in order is unfinished business. Is there any unfinished business? Is there any new business to come before the meeting?

Mr. J. T. CHAMBERLAIN. Mr. President, It is probably known to almost all, if not all, the members here that the secretary of the New York club, sometime during last week, was shot, and at 5 o'clock this morning he died from the effects of the wound. I think it very proper that resolutions be sent both to the New York club and also to the family of the deceased; and I would move that the Secretary be instructed to draw up two sets of resolutions, one to be forwarded to the family of Mr. Watson, the other one to the New York club.

(The motion was seconded by Mr. Medway.)

Mr. T. B. PURVES, Jr. Mr. President, I would like to inquire if the secretary was personally acquainted with Mr. Watson.

The Secretary. I never met Mr. Watson. I do not know him personally.

Mr. Purves. I understand that Mr. Medway in years past was a personal friend of Mr. Watson. I think it would be eminently proper to have a committee of two or three appointed to prepare the resolutions, and leave them to the Secretary to send. I think a committee would be better able to prepare them, especially if one of the committee has been acquainted with Mr. Watson. Therefore I make that amendment.

(Mr. Adams seconded the amendment.)

Mr. Chamberlain. I will accept the amendment.

The President. Then the motion stands that there be a committee of three appointed to provide suitable resolutions on the death of Mr. Watson, one copy to be presented to his family and the other to the New York club. Are you ready for the question?

(The motion was unanimously adopted.)

The President. I will appoint on that committee Mr. Medway, Mr. Chamberlain and our Secretary. I would ask if it is your purpose to have those resolutions prepared this evening.

Mr. Purves. Oh, no.

Mr. F. D. Adams. I would suggest, Mr. President, that they be prepared so they can be presented at the next meeting, a week from Thursday night.

The President. I should think the suggestion was a good one. The committee hears the suggestion. The next thing in order is the reports of committees. Are there any committees to report?

Mr. Chamberlain. I would say in behalf of the committee on rules of interchange for my friend Mr. Adams' information, that immediately after lunch at Cleveland two weeks ago we adjourned to meet in New York to further perfect tbe arrangement. (*Laughter.*)

Mr. Adams. Immediately after lunch? (*Renewed Laughter.*)

The President. The next item of business is the election of officers. Previous to that I believe there is a nominating committee to report, and also the reports of our Secretary, Treasurer, Auditing Committee, etc. We will hear the report of the committee on nominations, after which we will call for the other reports.

Mr. Adams. I would say, Mr. President, as chairman of that committee, three of us met. The committee was composed of five. Mr. Chamberlain was in Cleveland, I suppose taking lunch, and Mr. Twombly was very sick. The members of the committee who were present, Mr. Sherburne, Mr. Barnard and myself, hesitated somewhat about making the nominations, but we finally concluded that we would

make the nominations and submit them for approval. We have nominated as follows:

For President, L. M. Butler.

For Vice-President, John Medway.

For Treasurer, Charles W. Sherburne.

Executive Committee, L. M. Butler, C. E. Fuller, J. T. Chamberlain, T. B. Purves, Jr., Henry Bartlett.

Finance Committee, L. M. Butler, F. E. Barnard, George H. Wightman.

This makes the complement of officers necessary according to the constitution.

A MEMBER. The Secretary's name was not read.

Mr. ADAMS. The Secretary is not an elective officer.

The PRESIDENT. We will now hear the report of the Treasurer. Is the Treasurer here?

The SECRETARY. He is not. I have his report.

NEW ENGLAND RAILROAD CLUB.

Report of the Treasurer from March 13, 1895, to March 10, 1896.

DR.

1895			
Mar. 13.	Cash on hand	$1,513.00	
	Received from the Secretary: —		
	For dues	970.00	
	" Advertising	2,665.00	
	" Receipts from Excursion	316.40	

CR.

1895			
Mar. 13.	Amount paid on approved vouchers: —		
	For Printing, Mailing and Stationery		$1,463.27
	" Stenographer		135.50
	" Secretary		550.00
	" Entertainments		446.82
	" Excursion		603.26
	" F. M. Curtis, Commissions on Advertisements, 1895		270.00
	" Expense of Committees		24.85
	" Crayon of Mr. Lauder		33.25
1896			
Mar. 10.	Bal. on hand in Globe National Bank		1,937.45
		$5,464.40	$5,464.40

The PRESIDENT. We will hear the Secretary's report.

Mr. President and Members of the New England Railroad Club : — It is my pleasure to present to you the report of this Club for the past year,— a year in its history not marked by an extraordinary growth in any particular direction, but one of influence and a high class of work, broadening towards the greater fields of mechanical development.

Our membership of 399 one year ago has been decreased by resignations and for non-payment of dues twenty, and by death two, and *increased* by addition of new members fifty-eight, making a total membership to-night of 435. There are forty members whose dues for the year are yet unpaid, but we hope these will make payment at an early date and thus retain their membership with us.

Early in the year, April 29, 1895, the Club sustained a loss in the death of its Treasurer, Mr. Charles Richardson, a man much respected and liked by all, a member active in the work of this Club, and who ever had its best interests at heart. The Club lost one other member by death during the year, Mr. John Sampson, who died May 5, 1895, at Providence, R. I. Mr. Sampson was known to many of you and had been a member of the Club since 1890.

The regular meetings have been fairly attended, yet not as well as we could wish. The largest attendance, 137, was on February 11, 1896, and the smallest, sixty-four, October 9, 1895, with an average through the year of ninety-three, a slight falling off from last year.

By reason of increase of membership of our own and other clubs with whom we exchange reports, it is now necessary to publish fully 2,200 copies monthly. The cost of such publication we are able to meet with the income received from our advertisements. We are again grateful to our advertisers for their interest and aid in work of the Club, and to this end, we are able to report the amount of $3,300.00 for the advertising pages of our book this year, more than half of this amount having already been collected. (I will here say that there are no advertisements for 1895 remaining unpaid.)

The work of the Club during the year has been, we believe, generally interesting, improvement and advancement along certain lines having been made. For those who may not have been present at all the meetings the past year, the subjects discussed and their dates, briefly given, are as follows : —

April 10, 1895.

Revision of Rules of Interchange for Freight Cars.

May 8, 1895.

Electrical apparatus in connection with signalling and moving trains. (At this meeting Mr. Chas. W. Sherburne was elected to office of Treasurer. Picture of Mr. Lauder was presented and accepted by Club.)

September 4, 1895.

This date the Club held its "annual outing," it being this year a "boat ride" to historic Plymouth. About 175 persons, including many ladies, attended, and all reported an enjoyable trip.

October 9, 1895.

Revision of Constitution and By-laws. Adopted.

November 12, 1895.

Air Brake Equipment, and its application to rolling stock. Paper by Mr. R. A. Parke.

December 10, 1895.

Number and location of Grab Irons or Hand Holds and height of drawbars, as applied to freight cars.

January 14, 1896.

Revision of Interchange Rules as recommended by Pittsburgh Committee of twenty-one, together with suggestions of Mr. A. M. Waitt.

February 11, 1896.

Substitution of Electricity for Steam as a Motive Power in the operation of Railroads. Address (with diagrams shown) by Mr. Jas. F. McElroy, and papers by Mr. L. H. Parker and Calvert Townley.

While we have, I think, cause for congratulation as to the success of the Club, improvement can be made in the direction of greater interest manifested in our work, and also toward an increase of membership. Concerning the latter, it seems to me we might profitably follow the example of some of our sister clubs, which have not alone enlarged their membership, but have changed their character somewhat by the addition of general managers, general superintendents, transportation men, purchasing agents, etc., etc., to their membership roll. This cannot be done by any *one* person, be he your president, your secretary, or member of your committees, but it should be the interest and work of *each* and *every* member.

It is very gratifying to note that a few of our members, particularly new ones, have done quite a little in this direction; but let us *all* make an effort to the end of an enlarged and broader membership this year, which will bring to our Club increased interest, greater success and a broader and higher standard attained.

Respectfully submitted,

EDWARD L. JANES,

Boston, Mass., March 10, 1896. *Secretary.*

The reports of the Secretary and Treasurer were greeted with applause and were accepted.

The Secretary. I have a letter here from Mr. C. F. Quincy addressed to the Club. He asked that the following be inserted in our report :

Chicago, February 15, 1896.

New England Railroad Club,
Boston Mass.

Gentlemen: — Will you kindly notify your readers that Mr. Stanley E. Russell, representative of the Q. & C. Company at Atlanta, Ga., died on the 13th inst., of pneumonia.

Thanking you in advance, we are,

Yours very truly,

C. F. QUINCY.

The President. We will now hear the report of the Finance Committee. Is the chairman of the Finance Committee present?

Mr. F. E. Barnard.

Boston, March 10, 1896.

Mr. President and Members of the New England Railroad Club: — Your Finance Committee have this day examined the books and accounts of the Secretary and Treasurer and find them *correct.*

A. G. BARBER,
GEO. H. WIGHTMAN, } *Committee.*
F. E. BARNARD,

The President. I believe that finishes all the business preliminary to the election of officers, and I will say that although our nominating committee have nominated names to be balloted upon for officers for the ensuing year, the members are not bound to vote for those persons unless they wish to; and as far as I am personally concerned, I am quite as willing you would vote for someone else. I have held the office of president for the past year. We have had a successful year's work. The showing of our Club is very gratifying. Our increase of membership is gratifying, and the character of the members whom we have taken in is very satisfactory. While we have had several meetings on practically one subject, that is, car department matters, we were rather obliged to have them on account of the action taken at the Master Car Builders' convention leaving some questions to be decided by the Club, which took some two or three meetings to discuss and get into shape for their convention. One meeting was given to preparing a Constitution and By-laws to better fit the Club in its present large membership, the old By-laws being inadequate. We have had one meeting on electrical matters, — last month's meeting, — which was a very gratifying one, well attended, and points were brought out which were both interesting and instructive. I should be glad to see more such things

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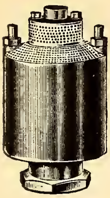

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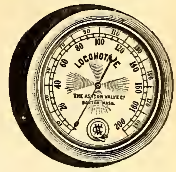

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brought before the Club. I should also be glad to see those men who are engaged in electrical matters become members of this Club, civil engineers, men connected with the maintenance or the construction of roads, etc. I would like these men to become members of the Club and bring in new topics to be discussed; and I hope every member will feel if he can bring any of these men in here, we shall greet them with pleasure and give them a hearty welcome. I have no further remarks to make at this time, and we will proceed to the election of officers. I will appoint as tellers Mr. Richards and Mr. Leach.

Mr. J. W. Marden. Mr. President, I understand that we have an interesting paper to be read here this evening, and I would make a motion that the names put in nomination be balloted for at one ballot, unless some one of the members makes an objection.

The President. That will require a unanimous vote.

Mr. Marden. I make that as a motion. I do it because I know we shall be short of time to have that paper read.

(Question was put and adopted.)

Mr. Marden. Mr. President, I believe that in voting in this way any one has the right to scratch any name on this list and insert another one if he wishes to vote for some one else.

The President. Certainly.

Mr. W. W. Whitcomb. Mr. President, I would make a suggestion. You have expressed the wish that the membership of this Club might be increased. Now, why wouldn't it be a good thing for the Secretary to send to the members a few blanks for them to fill out with the recommendation of whoever presents it. Sometimes if a man has a paper of that kind and passes it to a friend, he can get a name when otherwise he would not perhaps do anything about it. I have known other societies to do this to their advantage.

The President. That suggestion is a very good one, although there have always been blanks here at our meetings that members could have if they wished, and they are still here. Our Secretary could send out some, I suppose, without much trouble.

The President. We will now hear the result of the election.

Mr. Richards. Mr. President, I make the following report: —

Whole number of votes cast for President, 86. Mr. L. M. Butler has 85, T. B. Purves, Jr., 1. All the other names on the ticket received the full vote.

The President. Gentlemen, you have heard the report of the tellers, and the ticket as printed is elected. For my own part, I wish at this time to thank you for this expression of confidence in me, not that I think you could not have got a still better man to preside, or who might do more for your interest than I can do. But I will say right here, I

will do the best I can, and I want you all to help me. Come here and attend the meetings; take part in them, and assist in matter of subjects to be discussed, those that are alive, — and make yourselves alive, and make the coming year a prosperous one, both as regards the subjects that we take up here for instruction and any others. And also the social part, make that a good thing by your presence. I do not know that I have anything more in particular to say.

I will here announce the subject that we are going to take up for our April meeting. "Packing for Piston Rods and Valve Stems, and Relative Value of Different Types of Slide Valves." Now, there is a noble chance for men in the locomotive department of railroads to air their opinions and bring out all the new ideas they may have, and see what we can learn. We shall see how many have the courage to come here and tell us of some of their experiences. The paper to be read before the Club this evening is entitled "Along a Jamaica Railway," by Mr. C. W. Willis.

Mr. C. W. Willis. Gentlemen of the New England Railroad Club, my paper is not long. I have only attempted to picture a few novel sights and scenes along the line of the Jamaica Railway, and to show that the railway, even in this somewhat remote and not very widely known West India Island, is by no means an institution of recent date, and to give some idea as to the peculiar methods and rather antiquated way of constructing a line which is now in process of building along the north coast of the island. I did hope to show the Club a series of original stereopticon views, but found it was not practicable, and so defer that to some later date, perhaps.

ALONG A JAMAICA RAILWAY.

By C. W. Willis.

From necessity, this paper must be devoid of technical expressions typical of trained railroad men, and clothed in the language of a newspaper writer.

In speaking of the Jamaica Railway, I shall endeavor to give some information about the curious tropical land in which it is located; but, to me, the wonders of this fair Isle of the Caribbean are so nearly inexhaustible that I shall confine myself to the range of vision from the line under construction at the time of my last and recent journey, and from the car windows on the lines now being operated.

It may, however, prove desirable to allude briefly to the geographical position of Jamaica, and to its climatic and physical characteristics. The Island is situated between seventeen degrees forty-three minutes and

eighteen degrees thirty-two minutes north latitude, and seventy-six degrees eleven minutes and seventy-eight degrees twenty minutes fifty seconds west longitude. It is located ninety miles south of Cuba, 100 miles west of San Domingo and Haiti, 445 miles north of Cartegena in the South American Republic of Colombia, and 540 miles from Colon. All the Mexican states and Cuba are far to the north of Jamaica, and those Central American countries opposite to the west are Honduras, Guatemala and Costa Rica.

Thus it is seen that Jamaica is located in the heart of the tropics, in the midst of the blue Caribbean. The nearest part of the Continent of America to Jamaica is Cape Gracios á Dios (Cape Grace of God, in the Spanish vernacular), in the Mosquitto Territory, 310 miles to the west.

Jamaica is extremely mountainous, terrace upon terrace of ranges rising one above the other as we proceed inland from the coast, their summits draped with fleecy clouds, crowded together in an apparently incomprehensible jumble to the loftiest elevation of the Island, — Blue Mountain Peak, — which is 7,360 feet high. These mountains are intersected by deep gorges and narrow passes through which rush almost countless swiftly flowing streams ; while at the higher altitudes, broad, level savannas or grazing lands are met with. These mountains from the coast to the highest peak are clothed with the densest and most luxuriant tropical verdure. This very mountainous character is typical of all the West Indian islands, and the underlying foundation is composed of igneous or volcanic rocks, which are overlaid by several formations, the chief of which is a soft, calcareous limestone rock, of coral origin, — and this soft coral rock is the one which the railway engineers principally have to encounter.

It must be borne in mind that Jamaica is a British possession, and one of her oldest colonies in the new world ; and when the American Colonies were struggling for independence, Jamaica was an island rich in the production of sugar and that beverage which has made her name famous the world over.

The original Jamaica railway was incorporated in 1843, to build a line from Kingston, the present capital, to Spanish Town, the old capital, a distance of twelve miles. This line was opened for traffic in November, 1854, and an extension to Old Harbor, eleven miles distant, was opened in July, 1869. In 1877 the Colonial Government of Jamaica bought the line from the controlling company and made many improvements in the roadbed and equipment. The permanent way was relaid and ballasted, steel rails were substituted for iron, old wooden bridges and draws were replaced by bridges with concrete abutments and wing walls, wrought iron superstructures, and new arches were built of concrete. Several new stations were also built.

These historical details may seem uninteresting, but they are almost necessary to bring me to a later date, that of my first visit in 1890, and my second in 1895.

In December, 1881, a contract was given out for the extension of the line from Old Harbor to Porus, in a northwesterly direction toward the interior, a distance of twenty-four and one half miles, and in the following January the work of construction was begun. This line was opened for traffic in March, 1885.

A branch from Spanish Town to Evarton, forty-four and one half miles, was next built, and opened in August, 1885. It was on this latter division that I had my first experience on a Jamaica railway, in November, 1890, the lines of which I have thus far spoken being then the only ones in operation. Indeed, no further work was at that time in progress.

In 1889 the West Indian Improvement Company, composed of American capitalists, was formed to purchase the railway from the Jamaica Government, and on January 1, 1890, the Company took formal possession. Up to and at this time, the English style of rolling stock only was used, — miserable little rattle-traps of compartment cars, and small locomotives looking somewhat like parlor stoves. These same engines and cars are still in use on the Evarton branch, for the reason that so small are the numerous tunnels under the palm-covered mountains, they will not permit American built cars to pass through. But on the other portions of the system, already mentioned, American engines and comfortable American cars are in use.

I will here depart a little from my subject in a strict sense, and try to describe my ride from Evarton to Kingston, something over forty miles. The little station stands in the midst of a grove of cocoanut palms. It is a light, airy structure, with a wide portico at one end. The station officials, ticket agent and telegraph operator are all black, and all extremely courteous, an indication that Jamaica railways have attained one condition which thus far has been but a dream and a flight of imagination with regard to American railways, too altogether improbable to be realized either in this or the next century; and I refer in no way to officials and railway men holding positions such as those occupied by members of this Club.

The little train stood on the track a short distance away, ready to back down for the passengers. The cars were small and very light, and the wheels all had spokes like carriage wheels; the cars were old and showed the ravages of the climate, and were almost devoid of paint, both inside and out. They are divided into compartments, and there are first and second class carriages. For the benefit of any who may in the future travel in Jamaica, I will explain that the difference between first and

second class is largely a choice of "niggers." In the first class coach the passengers will probably wear shoes, and there are very thin cushions on the seats; while in the second class, the passengers are barefoot and there are no cushions. But the difference is slight, so save your money and ride second class. The cars are entered at the side, and the seats, two in each compartment, face each other, so if the compartment is full a part of the passengers must certainly ride backward. A running board extends along each side of the car.

The tiny, English-built engine, though the road is standard gauge, stood blowing off steam furiously, and the black engineer and fireman lounged lazily in the cab — for, owing to the torrid climate, the engines are provided with cabs. Soon the engine was coupled to the cars and the train backed down to the station. Then the shrill whistle began to blow and it blew steadily for about two minutes. I was told that it is customary to blow the whistle two minutes, fifteen minutes before it is time for the train to start, though it seemed to me to be just the other way. There is no bell on the engine. Soon we were seated in our compartment, as good luck would have it being the sole occupants, — myself and wife, — and the starting time arrived. The black conductor blew a small whistle, the engineer answered with a shrill blast, and away we rattled over this curious West Indian road, winding across the plain of St. Thomas in ye Vale, between the green hills, over high viaducts, past groves of palms and fields of cane, banana and plantain plantations and mangrove swamps, every now and then seeing a great black bee-hive like structure, fully as large as a bushel busket, perched high in some great tree, the home of the tree or nest-building ants. We stopped at frequent stations about which congregated people of all sizes, colors and conditions of life, some of them in astonishingly abbreviated costumes; and at one of these stations, the last before we entered the first of the many tunnels, we heard the sound of feet on the roof of the car, and were somewhat amused to see a lighted lamp lowered down through a hole in the roof — reminding the passengers to make ready for the tunnel. Away again we sped, half of the time going at a tremendous speed by the force of gravity alone, until we saw the blue Caribbean spread out before us, soon reaching the city of Kingston.

I will now refer briefly to the operations of the American company, — the West Indian Improvement Company, — which at the present time controls the road. The work of extending the line was immediately begun, and in January, 1891, the line was opened for traffic, twelve and one half miles from Porus, and in March, 1892, trains were run on eighteen more miles. In 1894 the railway was finished to Montego Bay, on the north coast, the main line running from Kingston to Montego Bay being 105 1-2 miles long.

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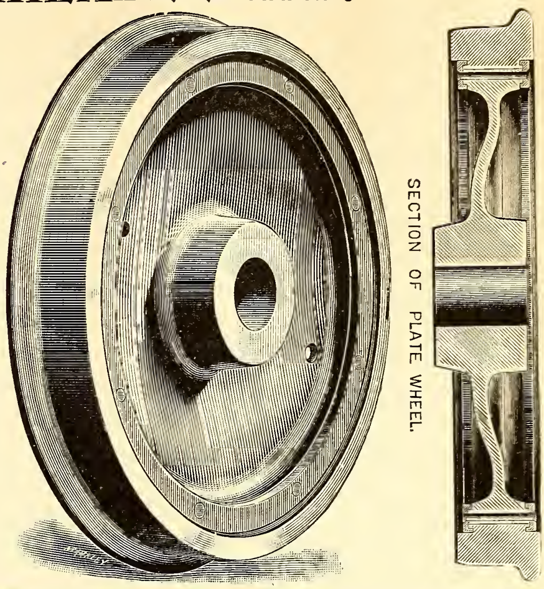

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And now I come to what is known as the Port Antonio extension, in process of construction at the time of my visit in October last, most of which will be open to traffic in about three months from this time. Port Antonio is the greatest banana shipping port of Jamaica, and is the headquarters of the colossal Boston Fruit Company, whose weekly steamers sail from Boston to that port and whose plantations stretch along the eastern end of the island for more than one hundred miles of coast line. The terminal station has been constructed here, and it stands where, at the time of my visit in 1890, was only a spongy morass. This swamp has since been largely reclaimed by planting cocoanut palms. A great number of wooden piles were driven down very close together, one above another, until a solid foundation was secured for the station. The imported labor brought out by the Company consists of Italians, with American superintendents. As the climate of Jamaica, though healthy in most parts of the island, is divided into wet and dry seasons, the climate of the coast, in many places, is very trying for all but the native blacks, and as they are not to be depended upon to any great extent Italians were brought to the island. The white people suffered greatly from the coast fever, and many died. I remember one poor fellow, down with the fever, whom I called to see while at Annatto Bay. He was bravely struggling against it, but he died before I sailed for home.

From Port Antonio, the line now being constructed runs westward along the coast, now close to the water's edge, and now high up along a narrow shelf cut out of the white coral rock, to Annatto Bay. All the stone used for ballasting purposes is the soft rock of which I have spoken, and it is all broken up into small pieces by native black women. They sit along the line, upon heaps of broken stone, sheltered from the powerful sun's rays by rude shelters of palm leaves, and, day after day, pound away at the soft stone with hammers, breaking it into small fragments. They are paid so much a barrel for the work, and earn from nine pence to one shilling a day, eighteen cents to twenty-four cents. All this ballasting material is distributed along the roadbed by these women, who carry it in small round baskets and trays, each holding from twenty-five to fifty pounds. Not only this, but every mile of railroad in Jamaica was constructed in this manner; and not only is this stone ballast all carried on their heads by these women, but every particle of the material for embankments, and all the gravel and filling material, — and at Annatto Bay I saw long lines of black, barefooted and bareheaded women carrying sand from the seashore to the line of the road a quarter of a mile away. These women seem perfectly happy, and are always talking and laughing. But they will do a wonderful amount of work in a day, and the reason for employing them is because it is cheaper for the same amount of work done than by any other way.

The ties are all brought from the United States, as are the rails, which are steel, of what weight I do not know, but I should think somewhat lighter than those recently laid on the Western Division of the Boston & Maine, and about like those to be found on the Maine Central road at the present time.

From Annatto Bay, where the line leaves the coast, to Spanish Town on the south coast, the road passes through a hilly, mountainous and very broken country, and heavy work was encountered in the construction, necessitating many tunnels and viaducts, there being twenty-three tunnels within a very few miles. But the rock is so soft that but little blasting is required, most of the tunneling being accomplished with picks. The interior walls and roofs of the tunnels are reinforced by timber superstructures, filled in with English Portland cement. About ninety-eight bridges and fully arch culverts are required on the sixty-one miles of this extension—none of them, of course, being of great length.

The line, when completed, will be equipped with American rolling stock; and while the traffic will be largely of a mercantile character, I look forward to my next visit, when I can make a comfortable trip at a reasonable expense between Annatto Bay and Kingston, a distance of thirty-one miles, instead of paying three pounds, fifteen dollars, for a team to take me that distance, as on my recent journey.

The President. Gentlemen of the Club, you have heard this paper that has been read by Mr. Willis. I am ready to hear any motion which may be offered.

Mr. Adams. Mr. President, it has been a very interesting paper, and I move we extend Mr. Willis a vote of thanks.

(The motion was seconded and carried.)

The President. Is there any other business to come before this Club?

Mr. Adams. Mr. President, I rise to make a motion, but before I make the motion I want to make an explanation or sort of preamble, in regard to the election of our officers. It has been somewhat of an unwritten law among us that our officers should hold their places for two years in succession. It has been the practice ever since the Club was organized; but we have had a good many really smart young fellows here among us who, I suppose, are ambitious to preside over this Club, and I think it is well to give them an opportunity, and we should double the opportunities if the office is not held but one year. Now, I would make a motion, Mr. President, that from this time forth our presiding officers, the President and Vice-President, I will confine it to them, — I was going to say disfranchise them, but I mean that they shall not be subjects of election again; that they be confined to one year's service.

It seems to me that it would give our members a little better opportunity to hold the positions. I know that some of them would like to fill, and can fill, the places with honor, and consequently I make this motion to accomplish that object. I do not know how the rest of them feel about it. I have talked with but a few, but it has been suggested by a few that we adopt something of this character. We concluded it would be hardly fair to do it without a vote, and I would make this motion, that from this time forth the office should only be held by a person one year. I would also make another suggestion in the hope that it may create a little enthusiasm, that there be two tickets in the field every time, one by a nominating committee and the other by a an independent nomination, if somebody will take the responsibility of making it. (*Applause.*)

The PRESIDENT. I would say to the Club that this matter which Mr. Adams has just brought before the Club was suggested by me to Mr. Adams to be put in force at this time. I said that I was perfectly willing to vacate in favor of a successor; in fact, I would be as willing to do that as not. I do not know whether it was out of spite or not I was renominated. I have been out to see him twice, and he was not there.

Mr. ADAMS. I was getting ready to go away.

The PRESIDENT. It is moved and seconded that in the future the office of President and Vice-President be held by the same person one year; that is, they are not to be re-elected to a second term.

Mr. R. J. DAVIDSON. Do I understand they are not eligible to the office again, or should not hold office for two successive years?

Mr. ADAMS. The idea was that they were not to be eligible, for the reason, as I said before, that we have so many young men here that we want to see put in the office of President. I think it is their right to claim it, and it would be fair for us to give them an opportunity to preside over the Club, and we cannot do it if we re-elect the old officers. It would take a good many years, and they would die off before that time.

Mr. RICHARDS. Mr. President, I think it is a good idea to give them all an opportunity, but judging from our Secretary's report, some of them will have to wait about four hundred years before their turn comes.

Mr. ADAMS. They will have to take their chance on that.

Mr. CHAMBERLAIN. Mr. President, we might as well do this right. I am perfectly in accord with Mr. Adams, but I do not see how he can do that; I do not believe he can, and I would make an amendment to Mr. Adams' motion. The motion would be something like this, that it is the sense of this Club that it it is unwise and inexpedient to re-elect the President and Vice-President for a second successive term.

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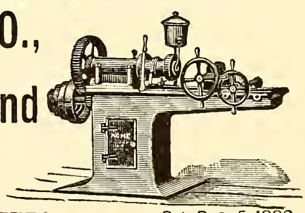

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Mr. Adams. Mr. President, I think Mr. Chamberlain has put the thing in far better language than I did, more grammatical and better expressed.

Mr. Chamberlain. That comes with very good grace from Mr. Adams, considering that he coupled me with himself and called us both two illiterate persons not long since. (*Laughter.*)

(The motion of Mr. Chamberlain was seconded and adopted.)

The President. Is there any other member of this Club or visitor who has anything to say for the benefit and interest of the Club? If so, now there is an opportunity.

Mr. W. W. Whitcomb. Mr. President, I have been a member of this Club for two years. I have no disposition to come before the Club, but I suppose I have the right to claim that my father wrote the first article that was ever published on railroads in this country. It has been discussed in the papers a great deal. I have the original documents right here in Boston. I have a letter in my pocket that was written in 1868, when the gentleman was seventy-six years old, relating to railroads, and I will take but a few moments to read it. I think there are matters in it that will interest the members of this Club, if you care to hear the letter read. I think I have carried this letter since 1868. It was written on the occasion of holding a railroad meeting here in Boston, the old Ogdensburg North Transportation Co. I wrote making some inquiries about that, and called out this letter. I might also add that this gentleman made a trip through that northern country with T. P. Chandler and Judge Hopkins of Ogdensburg before the road was ever surveyed. He went very much as Mr. Coffin went out over the Northern Pacific route.

"While I do indeed rejoice in the recent movements of this generation of American Merchants, Forwarders and R.R. Companies to expand the Internal Trade and Commerce of our Heaven favored country, my mental capacities do not readily supply the recollections for which you ask. And yet I love to recur to a period when more than sixty years ago I began to become awakened to the vastness of our Western domain — its Lakes, Rivers, luxuriant productive soils, and capacities for settlement. The Boston newspapers of 1805 to 1808 had acquainted me with the expedition of Captains Lewis and Clark, under President Jefferson's illustrious patronage, to explore the Louisiana purchase up the Missouri River and in search of the head branches of the 'Columbia' or Oregon, and down thence to the Pacific Ocean. About 1807 their return and Reports announced the success of their Enterprise and two volumes compiled from their Journals were published. I date my own first perception and forecast of the future grandeur of our American Republic with devout thanksgiving, to the perusal of those volumes.

"In 1809 I became a traveller, and soon had visited the New England States, and three of the Middle States; then the old Southern States; and in 1818, went into Ohio, Indiana, Illinois, Missouri, Kentucky, Tennessee, and Alabama. My mind was filled with the ideas of Canals and Roads by which intercommunication between these and our Eastern Cities could become facilitated.

"I had read everything I could from the noble DeWitt Clinton's pen, on Internal Improvements in his own New York, and explored the line of his Canal. I had conversed with Elkanah Watson, one of his Engineers, and had called on Mr. Clinton himself on this subject. In 1820 to 1822, I had written articles in the Edwardsville (Ill.) 'Spectator,' edited by Hooper Warren, in suggestions of Canal connexions between that and the other portions of the northwestern territory, and advocated this in public Debating Societies.

"In 1824 (possibly earlier) I commenced writing on these subjects in the 'Boston Patriot.'

"The object of these articles was to induce my native state (Massachusetts) to survey a route for a Canal from *Boston* to *Albany*, N. Y. While urging this project, I received from Washington a Report of a gentleman who had been sent to Europe to examine Canals, &c., with a view to the interests of Pennsylvania between Philadelphia and Pittsburg, and herein got my first idea of *Railroads* or *Railways*.

"I then believed that such work should be constructed by the State and Federal Governments, and with exclusive reference to the *general welfare*.

"I could not perceive the statesmanship of entrusting to Corporations, Brokers' Boards, &c., the development of great national Interests and Enterprises, when we had a Federal Government established for the especial achievement of those grand Results.

"The formation of Boards of Trade, Commerce, Navigation, and Internal Transportation — the Conventions like that of last week at Boston, awaken new hope. Accept my feeble but hearty cheer. Allow me to congratulate you one and all. Collect statistics, compare ideas and propositions, talk over all your respective interests and wants, acquaint yourselves with one another, and then tell CONGRESS, the NATION, and the WORLD what you demand. Be assured that the interests of *the whole*, Farmers, Manufacturers, Forwarders, Exporters, and every other useful class of fellow citizens, will be advanced by united and concentrated counsel and action.

"Say to your friends of the Northern Transportation and Ogdensburg and Champlain R.R. Company, that though I am chilled by the frosts of age and winter, I watch their movements with intense interest and hope. Should I be permitted to hunt up my old papers and corres-

pondence, and post up my memory, I will furnish anything in my power to aid them. You are aware that I have preserved somewhere the papers I wrote and published when my excellent friend, the Hon. James G. Hopkins, first visited Boston on behalf of the Ogdensburg Railway project.

"I wrote a series of papers for the 'Boston Recorder' while Rev. Asa Rand was its Editor, on Illinois, which I wish you also to see and keep, as they probably had some bearing on Internal Improvements."

I will say, Mr. President, I will bring in those papers sometime. I value them very highly and keep them in my safe. I think Mr. Adams would like to look at them. I think they go back to 1824.

The President. Has any other gentleman anything to say?

Mr. Adams. I will simply say that I have been very much interested by Mr. Whitcomb's letter. I think it is something that interests any one who likes to hear of the early efforts made to open the highways of the country. And I think it would be very desirable indeed if Mr. Whitcomb could be induced to give those old papers, or put them in the hands of some of our present railway papers, that they might be printed, so that the younger people might see what was done and what the labors were to be performed in constructing the railroads of the country. I borrowed a book the other day of our worthy Treasurer that goes back to the early starting of railroads in this country, in this section particularly. It is very interesting indeed. I have read a good many articles in it. It is very fine. It calls up reminiscences of the olden times. I think that Mr. Whitcomb has been very kind in introducing that letter here for our interest, and I move that a vote of thanks be passed.

(The motion was seconded and adopted.)

The meeting adjourned at 9.30. 108 members present.

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(Corrected to March 25, '96.)

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195 Church Street,
Newton, Mass.

Adams, George F.,
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Joint Inspector, F. and B. & M. R.R. Cos.,
Ayer, Mass.

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Akers, George J.,
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Allen, W. A.,
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Portland, Mass.

Ames, Azele, Jr.,
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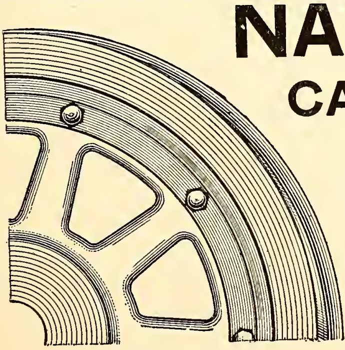

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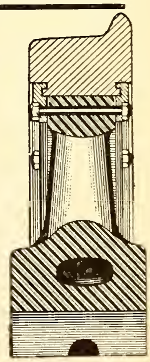

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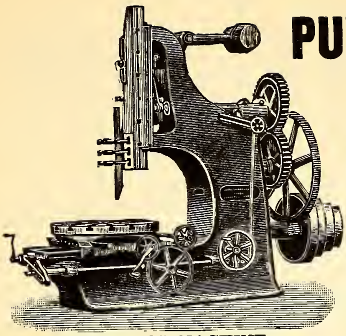

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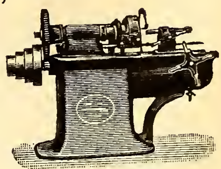

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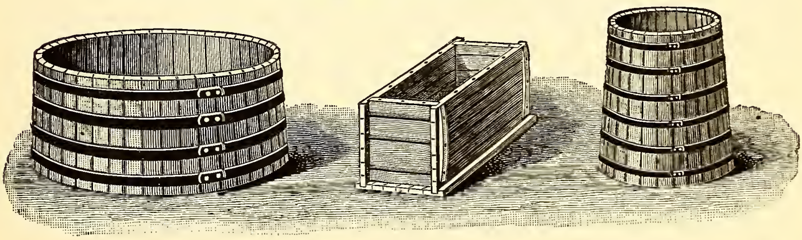

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Robinson Radial Truck,
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707 Betz Building,
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Philadelphia, Pa.

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Oldtown, Me.

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350 Atlantic Avenue, Boston, Mass.

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Massachusetts Institute Technology,
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Chelsea, Mass.

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Thompson, John S.,
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Boston, Mass.

Thompson, A. W.,
Care of Continuous Rail Joint Co.,
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Twombly, Fred. M.,
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Tyler, Willard C.,
189 Broadway,
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Tyler, William P,
Care of Tyler Tube and Pipe Company,
Washington, Washington Co., Pa.

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Monterey, Mex. Gulf R.R.,
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Roadmaster, B. & M. R. R.,
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69 Berkeley Place,
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Whall, Frank R.,
620 Atlantic Avenue,
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Whitcomb, William W.,
620 Atlantic Avenue,
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Whiteley, F. W.,
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Wightman, George H.,
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Concord, N.H.

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Boston, Mass.

Winans, W. G.,
66 Maiden Lane,
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Wood, Fred E.,
51 Beverly Street,
Boston, Mass.

Woods, John M.,
31 Lancaster Street,
Boston, Mass.

Young, William W.,
620 Atlantic Avenue,
Boston, Mass.

Young, John V.,
Superintendent Signals, B. & M. R.R.,
Boston, Mass.

Zehnder, C. H.,
Car Builder,
Berwick, Pa.

Zehnder, William D.,
Care of Pennsylvania Bolt and Nut Co.,
Lebanon, Pa.

LIST OF SUBJECTS BEFORE CLUB

Jan., 1890, to Jan., 1895.

Jan., 1890.	Notes on European Travel.
Feb., "	Freight Car Couplers.
Mar., "	Annual Meeting.
Apr., "	Locomotive Boilers.
May, "	The Length of Rigid Wheel-base permissible on American Railroads.
Sept., "	Annual Dinner.
Oct., "	Steel-tired Wheels; Method of equalizing their Wear, and Machinery for turning them off.
Nov., "	The Economy and Safety of Swing-motion Trucks as compared with Rigid Trucks.
Dec., "	The Best Form and Application of Brake for the Driving Wheels of Locomotives.
Jan., 1891.	What constitutes a Defect in a Vertical-face Coupler Sufficient to condemn the Coupler?
Feb., "	The Painting and Varnishing of Railway Rolling Stock.
Mar., "	Annual Meeting and Discussion — "Screw Stay Bolts for Locomotives."
Apr., "	Air Brakes for Freight Trains; their Care, Condition and Efficiency.
May, "	Rules for the Interchange of Freight Cars.
Oct., "	The Lighting of Passengers Cars.
Nov., "	The Care of Steam-heated Cars at Terminal Points.
Dec., "	Tools and Machinery for Railroad Work.
Jan., 1892.	Locomotive Boilers and their Attachments.
Mar., "	Annual Meeting, and Discussion.— "Freight Car Trucks."
May, "	Address of Col. Frank H. Forbes. "Rule 8 of the Code of Rules of the Master Car Builders' Association, and other Rules that may be suggested."
Nov., "	Higher Speed of Railway Trains; System and Appliances necessary to accomplish it.
Jan., 1893.	The Substitution of Steel for Iron in the Construction of Rolling Stock.
Feb., "	Railroad Building, with reference to Economy of Operating.

Mar., 1893.	Annual Meeting and Discussion. — "Air Brakes, with special reference to their Application to the Front Wheels of a Locomotive."
Apr., "	The Past Winter's Experience in the Continuous Heating of Passenger Trains.
May, "	The Desirability of having Standard Trucks and Foundation Brake Rigging for Freight Cars, and the Influence this would have on Repairs.
Oct., "	The Desirability of placing Deadwoods on Cars where the M. C. B. Type of Coupler is used.
Nov., "	Permanent Way and Rolling Stock, and their Relation to Each Other.
Dec., "	Locomotive Boilers and their Attachments.
Jan., 1894.	Railroad Building, with reference to Economy in Operating.
Feb., "	Lubrication of the Journals on Rolling Stock, and the Cause of Hot Boxes and What can be done to Obviate Them.
Mar., "	Annual Meeting. "Some Incidents of Life in Mexico"; by F. M. Twombly.
Apr., "	Railroad Switching and Yards; by E. K. Turner.
May, "	Air Brakes; Inspection and Maintenance.
Oct., "	Ventilation of Passenger Cars.
Nov., "	Norway; by W. W. Snow.
Dec., "	Responsibility of Car Owners for Defects in Freight Cars.

CONSTITUTION.

ARTICLE I.

NAME.

The name of this association shall be the New England Railroad Club.

ARTICLE II.

OBJECTS.

The object of this Club shall be, first, to promote knowledge on all matters relative to the construction and management of railroads and their equipment which may be brought before the Club for consideration and discussion ; and second, to encourage social relations among its members.

ARTICLE III.

MEMBERSHIP.

The membership of this Club shall consist of persons connected with the construction, operation or maintenance of railroads, or of railroad equipment, who may be admitted by a majority vote of the Executive Committee, and the payment of the annual assessment.

ARTICLE IV.

OFFICERS.

The officers of this Club shall consist of—

(1) A President, who shall preside at all meetings of the Club, and perform the duties usually pertaining to the presiding officer. He shall also be a member and chairman of both the Executive and Finance committees, and shall approve all bills before payment.

(2) A Vice-President, who shall in the absence of the President perform all the duties required of that officer.

(3) A Secretary, who shall keep a record of the proceedings of the Club, notifiy all officers of their election and committees of their appointment, issue notifications whenever directed by the President, collect all dues, depositing same with Treasurer and taking his receipt therefor, and submit his account to the Club at the annual meeting, or oftener if required. In the absence of the President and Vice-President, he shall call the meeting to order and preside until a chairman is chosen. He shall also act as Secretary of the Executive Committee.

(4) A Treasurer, whose duty it shall be to receive all funds, pay all bills when approved by the President, and submit his account to the Club at the annual meeting, or oftener if required.

ARTICLE V.

EXECUTIVE COMMITTEE.

An Executive Committee, consisting of five members (including the President), shall be elected at each annual meeting, and serve for one year or until their successors shall have been elected, whose duties shall be to receive all subjects for debate and bring them before the Club at such times as they may judge most beneficial for their discussion. They shall also vote on all applications for membership, and shall act on all matters properly referred to them.

ARTICLE VI.

FINANCE COMMITTEE.

A Finance Committee, consisting of three members (including the President), shall be elected at each annual meeting, whose duties shall be to have a general supervision of the financial affairs of the Club, and to audit the books and accounts of the Secretary and Treasurer.

ARTICLE VII.

NOMINATING COMMITTEE.

At the meeting preceding the annual meeting, a Nominating Committee of five shall be appointed by the President, who shall present at the annual meeting a list of names for each office to be filled; and the nominee receiving the highest number of votes for each office shall be declared elected.

ARTICLE VIII.

ELECTION OF OFFICERS.

(1) The officers of the Club, except the Secretary, shall be elected by a majority ballot at the annual meeting, and shall hold their respective offices for the term of one year, or until their successors are chosen.

(2) The Secretary shall be appointed by a majority vote of the executive committee at its first meeting after the annual election, and his term of office shall terminate with the appointment of his successor. The Executive Committee shall have power, by a two thirds vote of all its members, to remove the Secretary and appoint his successor at any time.

The salary of the Secretary shall be decided by a majority vote of the executive committee.

(3) Any vacancy in office, which may occur after the annual election, may be filled at any regular meeting of the Club.

ARTICLE IX.

AMENDMENTS.

This Constitution may be amended at any regular meeting of the Club by vote of two thirds of the members present and voting, said amendment having been proposed in writing and read at a previous regular meeting.

BY-LAWS.

ARTICLE I.

TIME OF MEETING.

Section I. The regular meeting of this Club shall be on the second Tuesday of each month, except June, July and August, at 8 o'clock P.M.

Sect. II. The annual meeting shall be held on the second Tuesday in March.

Sect. III. The President may call special meetings at such other times as he may deem expedient, and shall do so upon the written request of at least five members.

ARTICLE. II.

QUORUM.

At any regular or special meeting, twenty-five members shall constitute a quorum for the transaction of business.

ARTICLE III.

PRESIDING OFFICER.

In the absence of both the President and Vice-President, a presiding officer *pro tem.* shall be chosen by the meeting.

ARTICLE IV.

DUES.

Section I. The annual dues of members shall be two dollars, and shall be payable at the annual meeting or within thirty days thereafter.

Sect. II. At the annual meeting of the Club, the names of those members whose annual dues are still unpaid for the year then ending shall be dropped from the roll, previous notice of at least thirty days having been given such members by the Secretary, and such persons shall not be eligible for future membership until all back dues are paid.

ARTICLE V.

The order of business shall be as follows :—

1. Approval of the minutes.
2. Reports of Committees.
3. Unfinished Business.
4. New Business.
5. Election of Officers.
6. Appointment of Committees.
7. Discussion of subject announced.
8. Announcements.
9. Adjournment.

ARTICLE VI.

PUBLICATIONS.

Section I. The proceedings, or such portion thereof as the Executive Committee shall decide, of the regular meetings of the Club shall be published (standard size, 6 x 9 inches), and mailed to the members of the Club, and to members of other similar clubs with whom exchange is made.

Sect. II. The published proceedings of the annual meeting of the Club shall contain the Constitution and By-Laws of the Club, together with a list of the officers and members of the Club.

ARTICLE VII.

AMENDMENTS.

These By-Laws, or any of them, may be suspended or amended at any regular meeting of the Club by a vote of two thirds of the members present and voting, said amendment having been proposed in writing and read at a previous regular meeting.

NEW ENGLAND RAILROAD CLUB.

Packing for Piston Rods and Valve Stems.

RELATIVE VALUE OF

Different Types of Slide Valves.

Meeting of April 14th, 1896.

Published by the Club,
EDWARD L. JANES, SECRETARY, P. O. BOX 663, SPRINGFIELD, MASS.

Next Meeting, Tuesday Evening, May 12, 1896.

OFFICERS FOR 1896-97.

PRESIDENT,
L. M. BUTLER,
Master Mechanic, N. Y., N. H. & H. R. R.

VICE-PRESIDENT,
J. MEDWAY,
Supt. Motive Power, Fitchburg R. R.

SECRETARY,
EDWARD L. JANES,
B. & A. R. R.

TREASURER,
CHARLES W. SHERBURNE.

FINANCE COMMITTEE.
L. M. BUTLER. F. E. BARNARD. GEO. H. WIGHTMAN.

EXECUTIVE COMMITTEE,

JOHN T. CHAMBERLAIN,
Master Car Builder, B. & M. R. R.

T. B. PURVES, JR.,
Master Mechanic, B. & A. R. R.

C. E. FULLER,
Supt. Motive Power, Central Vt. R. R.

HENRY BARTLETT,
Supt. Motive Power, B. & M. R. R.

F. D. ADAMS, President	March, 1883, to March, 1885.
J. W. MARDEN, President	" 1885, " 1887.
JAMES N. LAUDER, President	" 1887, " 1889.
GEO. RICHARDS, President	" 1889, " 1891.
FRED. M. TWOMBLY, President	" 1891, " 1893.
JOHN T. CHAMBERLAIN, President	" 1893, " 1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, April 14, 1896.

President Butler called the meeting to order at 8 o'clock, and said that the minutes of the last meeting as printed in the report would stand approved, no objection being made. Committees were then called upon to report, and Mr. John Medway presented the resolutions on the death of Mr. Watson prepared by the committee appointed for that purpose as follows: —

To the Officers and Members
of the New York Railroad Club.

By a unanimous vote of the New England Railroad Club, at its meeting on March 10, 1896, we were directed to convey to our sister club of New York our sincere regrets at the sad and untimely removal, by death, of your most efficient secretary, Mr. W. G. Watson. Those of our number who were honored by a personal acquaintance will remember with pleasure his pleasant, kind and generous characteristics; others who have listened to his cheerful yet forceful and logical remarks, as well as all those within the wide range of the literature of your association, will agree that his mission on earth was not in vain, and that the world is richer by his abode therein.

Sincerely yours,

JOHN MEDWAY,
J. T. CHAMBERLAIN,
EDWARD L. JANES,
Committee.

To Mrs. W. G. Watson.

Dear Madam: — At the meeting of the New England Railroad Club, held at Boston, March 10, 1896, we were, by unanimous consent, directed to extend to you the profound sympathy of the Club in your sad bereavement.

Our official, social and business relations with Mr. Watson were of such a pleasant and cordial character that we feel we shall, in no small degree, share your loss. Trusting that you may be blessed with health and strength to sustain you in your great trial, we are,

Sincerely yours,

JOHN MEDWAY,
J. T. CHAMBERLAIN, *Committee.*
EDWARD L. JANES,

Mr. Medway. I will say that a draft of the first resolution was sent to the New York Club, so that it might reach it in time for its last meeting, and it was read before the meeting; and a draft of the latter was sent to Mrs. Watson.

The President. Gentlemen, you hear the report of the committee on the death of Mr. Watson of the New York Club. What is your pleasure?

(On motion of Mr. T. B. Purves, Jr., it was voted that the report be received and the committee discharged. There was no unfinished business to be attended to, and under the head of new business the President said:)

In this connection our Secretary will read the list of new members that have been accepted to-night.

The Secretary. The Executive Committee have voted the following persons members of our Club, applications having been duly made.

C. B. Boers, Gen'l Storekeeper, N. E. R.R., Norwood Central, Mass.
P. O. Sauer, Storekeeper, Wagner Palace Car Co., Boston, Mass.
Charles E. Goodwin, B. & M. Car Shop, Lawrence, Mass.
John Briggs, 31 Batterymarch Street, Boston, Mass.
S. T. Reynolds, Foreman, F. R.R., Williamstown, Mass.
A. Brewer, Foreman, F. R.R., Troy, N.Y.
C. A. Bigelow, Foreman, F. R.R., Greenfield, Mass.
Wm. G. Bean, Div. Supt., B. & M. R.R., Boston, Mass.
John G. Whitham, Signal Dept., B. & M. R.R., Boston, Mass.
Henry C. Robinson, Asst. Supt., So. Div., B. & M., Boston, Mass.
Geo. D. Chapman, Mech. Eng'r, Fitchburg, Mass.
Guy E. Mitchell, Motive Power Dept., B. & M. R.R., Boston, Mass.
Carl B. Smith, Motive Power Dept., B. & M. R.R., Boston, Mass.
Chas. S. Hall, Motive Power Dept., B. & M. R.R., Boston, Mass.
F. T. Macdonald, B. & A. R.R. Co., Boston, Mass.

A. J. Gibson, Joint Car Inspector, Southern Pac. Ry., Ogden, Utah.
A. J. Pitkin, Supt., Schenectady Loco. Works, Schenectady, N.Y.
T. Isbester, New York Air Brake Co., Chicago, Ill.
James E. Sague, Mech. Eng'r, Sche. Loco. Works, Schenectady, N.Y.
John Ewarl, B. & M. R.R. Co., Boston, Mass.
Edward N. Richards, Supt., Bemis Car Box Co., Springfield, Mass.
Henry F. Shaw, Corey Street, West Roxbury, Mass.
Thomas E. Sherwin, Engineer's Office, B. & M. R.R., Boston, Mass.
A. C. Holt, Treasurer, Norton Iron Co., Everett, Mass.

I wish to say at this time, that within a few days there will be mailed to every member of the Club one or two application blanks, according to a vote at our meeting last month, and we hope to add many more to our membership roll. I will also add that under the present arrangement our Executive Committee hold their meeting a few hours before this session, and applications for membership then come before them; those received here to-night have to lie over a month, but you can send them in through the month, and they will be acted upon at the next meeting.

The President. Is there anything else to be offered under the head of new business? If not, we will pass it. The next business will be the discussion of our subject, previous to which I will say that we have with us to-night a good many visitors, members and representatives of the Air Brakeman's Association, that are in convention here at this time, and have been invited to this Club. We heartily welcome them to this meeting. The topics for discussion are Packing for Piston Rods and Valve Stems, and Relative Value of the Different Types of Slide Valves. We will take up the first one. I believe that our friend Mr. Purves, of the Boston & Albany road, has something to offer on that subject, and we are now ready to hear him.

MR. PURVES.

Numerous and varied are the different forms of metallic rod packing now in use, but from the information I have at hand, there seems to be but two styles that are used to any great extent at the present time: *i.e.*, "the United States" and the "Jerome." By referring to the subject, you will understand that it is not within our province to say which of these two forms gives the best results. By this we mean which can be maintained at the smaller cost; also which will cause the least trouble to keep tight. I am not in a position to give any information regarding the cost or durability of any form of packing, except the "United States," as every locomotive on the Boston & Albany is equipped with this packing. We adopted it in 1881, and equipped every engine as soon

thereafter as possible, and it has given the best of satisfaction. Metalic packing, like all other parts of the locomotive, must receive attention in order to get the proper results; and if the different parts are carefully examined, and put in good condition when engines are in shop for general repairs, little difficulty will be experienced in maintaining it at a comparatively small cost until the engine is again taken to the shop.

We have found it more of a problem to maintain valve rod packing than piston rod packing. This may be attributed to several causes. The valve rod receives a motion from the rocker-arm that causes the ball joints to wear more rapidly in the former than the latter. The changing of the path of wear, caused by the variation of the travel of valve, and one of the greatest annoyances, is caused by the valve rod getting sufficiently low to allow it to come in contact with the cast iron packing case, thereby wearing the rod directly in the path of the packing rings. Provision is made to overcome this difficulty by inserting a bushing in the stuffing box or back end of packing case. This method will answer the purpose for a while, but the weight of rod and yoke being constant, renewals of these bushings are frequently necessary. Another important objection to sustaining the weight in this manner is that the rod also wears very rapidly at this point, and the life of the rod will be determined by this wear, rather than by the wear of the packing. In our experience we found it preferable to put all the weight of yoke and rod on the valve. To do this we place a wrought iron band around the body of the valve, the bottom of this band bearing on the wings of the valve, and being of sufficient height or thickness that when the yoke rests upon it it will maintain the centre line of rod above the centre line of steam chest. This same difficulty will sometimes occur with the piston rod packing where solid piston heads are used, and the bottom of head and bottom of cylinder become sufficiently worn to allow the piston rod to drop below the centre line of stuffing box, thereby throwing all the weight of these parts directly on the packing rings. I understand that the Old Colony Railroad is using a device to obviate this difficulty with valve rod packing. The diameter of the rod at yoke, and extending about six inches toward the end of rod, is one-fourth inch larger than original diameter, with a thread cut on to receive a composition sleeve. This sleeve wears on the stuffing box bushing, and is easily renewed when necessary.

We have also found it an advantage to cut the packing rings in two parts, which admits renewals without disconnecting the valve rod at union nut or knuckle joint, or removing the pistod rod from cross head. By avoiding the latter we eliminate in a measure the danger of fracturing the rod at this point, and which frequent driving of the cross head key invites. Another factor, and a very important one, too, in obtaining

good results from metallic packing, is to make it from just the proper kind of material. The best is none too good for this purpose. The following formula we have found very satisfactory: Copper, one part; antimony, two parts; Malacca tin, six parts; to each one and one quarter pounds of this mixture, add two pounds of tin. The quality of this Babbitt metal depends upon the quality of tin used. Good bread cannot be made from an inferior brand of flour; neither can good Babbitt metal be made by using an inferior brand of tin. If too hard, it will cause no end of trouble by frequent breakages; if too soft, it will wear rapidly, both on the rod and in the cone, and the smaller or inside ring will soon be forced through the packing cup. Lubrication also plays an important part in the efficiency of the packing rings, and we find some engineers do not give it the attention they should. Oil cups designed for this purpose should be kept in working order, and never allowed to run without covers; otherwise they will soon become inoperative by reason of sparks and dirt that accumulate in them.

The cost of maintaining metallic packing varies with the service of the locomotive. We find that in heavy freight service the cost is fully one hundred per cent. more than in switching service. The comparison is as follows, viz.: —

Cost per 1,000 miles,	switching engines,	15	cents.
" " " "	passenger "	21	"
" " " "	freight "	36	"

which gives an average cost per 1,000 miles of 25 cents.

This includes the material and labor required to manufacture the rings; also the time of the man who makes the application.

The President. Gentlemen, the subject is now open for anyone who has anything to say. There certainly must be somebody here who can give us some points on the question before us. I will call upon Mr. Medway.

MR. MEDWAY.

Mr. President. My experience has been much like that of Mr. Purves on the Boston & Albany. I use metallic packing on the piston rods of our locomotives with very good results, generally speaking. On new engines, mogul engines particularly, however, it has not operated so well. The reasons are, in my opinion, first, from high steam pressure; second, large pistons; and third, Laird guides. I think the plan of supporting the front end of the piston rod through the front of the cylinder head is a good one, because that relieves the weight of the piston from the bottom of the cylinder, and also the weight and friction from the metallic packing. I am not sure that it is generally used. The form of packing we use is a somewhat modified United States;

that is to say, the regular United States, I believe, runs part way metallic, running parallel with the piston rod, then a straight taper from there down to the forward edge of the ring. Some years ago, I recall, I used ordinary metallic packing, the United States packing, and we found this trouble, that it would wear just about so long, until the ring of the metallic packing would be cut in the corner of the vibrating cup, and would go no farther. Now, this theoretically will slide down until the ring is worn out.

In regard to valve stem packing, certainly metallic packing is quite as well adapted to the stem as to a piston rod, on account of the variable travel of the valve and the consequent unequal wear of the valve stem. And then we have quite heavy valve yokes, and it seems to me that we need a forward support also to the valve yoke. You remember, Mr. President, we used to have them, as a rule, with a support at the forward end of the valve yoke. Then again, we find that the valve stems have increased in size, while the stuffing boxes have not grown in proportion. Another important matter which Mr. Purves alluded to — the metallic packing, like the famous governors of North and South Carolina, must have constant lubrication.

The PRESIDENT. Mr. Richards, this is a subject that we would like to hear from you upon. Can't you say something about this packing business?

Mr. GEO. RICHARDS. I do not know that I can. I was in the packing business a good many years, and I have got through with it.

The PRESIDENT. We would like to hear some of your experience.

Mr. GEO. RICHARDS. Well, I will say one thing. At the beginning of the use of metallic packing, there were several months passed before I could even get a trial. I will speak of one case, the power-house of the West End. When they had the first engine from Milwaukee I went to Mr. Pearson and asked him to make a trial. He did not believe in valve packing. I went to Mr. Whitney and told him that we had a good thing, and I would like to have him try it. He called Mr. Pearson's attention to it, and finally gave me a letter to the Milwaukee people. I went to Milwaukee and saw them, and after spending something like two months they concluded to try it in one of the engines, and it was tried, and it proved so well that they have now a set on every engine; and they have something like two or three thousand dollars' worth of spare packing on hand. It is used all over the United States, as far as stationary engines are concerned.

In reference to valve packing wearing, they make packing, although they do not pretend to do locomotive work at all, that drops in the stuffing box, and they use now a ball joint with good success. I put in such packing in St. Louis at the big flour mill there, and when I came

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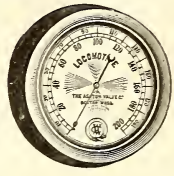

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to measure the engine and examine it, I found that the engineer, who they say was a very careful man, had been packing the piston rod with hemp packing, and in driving in hemp packing with a hammer he had hit the bottom so it was completely bunged up and battered. I called the superintendent's attention to it. The mill was then changing from old to new wheat, and I told him I would like to have him send to Boston for a set of packing made for the purpose, and put it in on trial, and if it did not suit him he need not pay for it. He said the engineer was out on the farm; he would send him in and have him take the engine apart and try a set of it. He called the engineer in, and I called his attention to the botton being completely hammered. I believe they hammered it down and draw-filed it, and put packing on. It was very bad from the word go. I know there was one time we did have some trouble once in a while on a boat, something of that kind, where under oscillation it did leak once in a while, but it was very, very rare. It was a system of packing never known much in railroad purposes, though they use it to-day. I heard the proprietor say the other day that they had a three thousand dollar order from England. Last year they paid something like, I think I am safe in saying, twenty or thirty thousand dollars for packing for stationary engine purposes.

The President. The question is open, gentlemen, for further discussion. We shall be glad to hear from anyone.

Mr. Medway. Mr. Chairman, metallic packing is used very generally on air pumps. I think we have a number of gentlemen here who can enlighten us on the subject.

The President. We have a good many of our air brake friends here, and they probably will have something to say about the working of metallic packing on pumps. I know from my own experience we have a good many pumps that have it on, and we are still putting it on. It works well. It is a good deal better than the old fibrous packing. It does not leak. I do not see any objection to it. Further than that I have nothing to say.

Mr. S. A. Randall. Mr. President, I would say that I have known of a set of packing put on an air pump; I have never known it to fail, while wearing up to 26. I have been out of the packing business a number of years, but I recall that from our worthy President's remarks.

Mr. F. M. Patrick. Mr. President, I am not a member of the Club, but I will say there is a packing known as vulca beston, a mixture of asbestos and rubber, which has been adopted by the Pennsylvania railroad as a standard, by the Baltimore & Ohio, and by the Westinghouse Air Brake Co., and they have had no occasion to use anything in place of it from the time they first commenced to use that packing. It is also made for valve stems, but it will not stand well the rapid motion of

the piston rod, for running seven or eight hundred feet. Unless they are lubricated it does not do good service.

The President. I would like to hear from Mr. Bartlett about his experience in packing.

Mr. Henry Bartlett. Mr. President, I do not think I can add very much to what has been said on the matter of packing. Of the seven hundred engines which we have to-day, three hundred and twenty are equipped with metallic valve stem packing and about five hundred and twenty-five have metallic piston rod packing. We are equipping all the others as fast as they pass through the shop. We are quite well aware of the fact that metallic packing is a paying investment. From what few figures I have on the matter, it seems to me that there is a saving of about five dollars per engine per year on metallic valve stem packing and about ten dollars per year on metallic piston rod packing. Those are general figures — about fifteen dollars per year an engine over hemp packing. Metallic packing has been known with us to run as high as twenty-seven months without any repairs. On an average it only runs twelve months, but often from fifteen to eighteen months with good care. Hemp packing as a rule takes repairs every two weeks perhaps, or something of that sort. We manufacture our own metallic packing. The company bought the right to do this some years ago. As to the cost of equipping an engine with metallic packing above hemp packing, I am not able to say just what that is. I presume it costs something in the neighborhood of five dollars more to equip an engine with metallic packing than with hemp packing. I have nothing further to say.

The President. I see Mr. Desoe, who has had some experience in this matter. We would like to hear from him.

Mr. E. G. Desoe. Mr. President, I do not know that I can offer anything that will be of much value, although I have had some experience on our road with metallic packing; also a considerable experience with the so-called vulca beston packing and fibrous packing. The trouble experienced with that packing was not that it failed to make a tight joint, but in some cases it would screw too tightly, perhaps unnecessarily tight, and an engineer might think it would cut the piston rod. I have known of quite a number of such things as that, but the greatest trouble we have with this packing is the renewing of it, it being packed so hard and compact that in some cases I have known where it was necessary to take the pump from the engine and take it apart in order to get the packing out without ruining the piston rod. I think that metallic packing, from what experience I have had with it, is far ahead of any other packing.

The President. I would say that we used United States metallic packing on about half of our engines. It is undoubtedly the cheapest

packing used, because the various kinds of fibrous packing are not very good packing; they do not last well. If there is nothing more to be said on this question of packing, we will pass to the next subject.

Mr. Gosselin. Mr. President, I would like to say that my experience has not been as wide as that of some of the older gentlemen who have spoken, but I would say that the Delaware & Hudson use a device in valve stem packing that is giving good results, and there is one engine which has been under good care for the last seven months, and I have not had any trouble so far with the valve stem packing, which is something quite unusual. They insert a sleeve over the valve stem with a double nut that comes against the joint. There is a very tight joint, and a very large valve stem for the packing to wear on. I think that the larger the stem the nicer the packing will wear and the longer it will last. I have used packing that was five-eighths of an inch larger than the diameter of the piston, and had it run fourteen months until the first ring was completely gone. The second ring, because we used only two rings, was more than half worn out when the bushing at the end of the spring would refuse to push it any further. Then it would have to be renewed. The most trouble we have had with valve stem packing is the keeping it at too fine a point, the box being considerably larger than the stem, which allows this nut to open the box slightly when the engine is dropped lower, and the larger part of the stem coming in contact it makes it slack, and consequently breaks the rings, and then it has to be renewed; so in order to get apparent satisfaction from it I have taken the valve stem packing and put it into a lathe and turned it large for the cup, so that this would hold it completely hard against the spring before you would have any chance to get in there and get any slack from it. With a good, careful engineer, who keeps some oil on the valve stem of his piston, we do not experience any trouble that way, and I would say, as far as our experience goes, I find that metallic packing gives good results.

If it is made in that way, it allows a better expansion; it does not break it, and consequently it will wear a good deal longer, and give a good deal better satisfaction all around.

The President. We have with us, I believe, Mr. Hutchins, who may have something to say.

Mr. Hutchins. Mr. President, I have not had very much experience with putting packing in air pumps, but I have had quite a number of years' experience with the Jerome packing in valve stems, and I must say that it has given entire satisfaction under all circumstances and conditions. I am using it now in connection with an engine on the Big Four, which has made in the neighborhood of 65,000 miles on a heavy passenger train, a limited train, and there is one valve stem

which has been repacked in that time, and that was recently. The piston, I think, ran in the neighborhood of 50,000 miles before it was removed to be repacked. The rings were entirely worn out.

As to air pump packing, I have a set of metallic packing in an air pump, put in there when it was first set up, and it has never been touched since. I do not know how much longer it is going to run, but it does not show any indication of giving any trouble.

The slight leaking keeps the lower packing lubricated, and it is the life of the lower packing. But the engine has a mileage of 65,000 miles, and the pump has never been touched. I will say in connection with that, that the oil cup on the air end of the pump has never been opened. There has never been a drop of oil put into the air cylinder or pump since it was built, and we never have had occasion to even touch the nuts on the stuffing box.

The President. Is Mr. Farmer in the house? If so, we would like to hear from him.

Mr. Farmer. Mr. President, I cannot add anything to what has been said from personal experience, yet I am aware that on the Northern Pacific they have a metallic packing which I believe is made of scrap. I do not know whether it is Jerome or United States. It is put in the stuffing box without anything additional except a piece of rubber to screw the end down on so it won't bind hard, and also so the end won't work off in any respect. That is all I can say about the matter, but if Mr. Goodman is here, the engineer from the Northern Pacific, he can possibly give you more information in regard to it.

The President. I would like to hear from Mr. Goodman.

Mr. Goodman. Mr. President, the packing which Mr. Farmer refers to is scrap, Jerome packing. We have been making it now about two years, and find it gives very good satisfaction. The slight leak, as Mr. Hutchins says, in the steam end, does lubricate the air end. I do not know that I can add anything more to what has been said.

Mr. Steele. Mr. President, I am connected with a road that uses Jerome metallic packing for air pumps. We adopted it as a standard about a year ago, and so far it has given perfect satisfaction. I find the same trouble with it as mentioned by this gentleman, that the stuffing box on the steam cylinder will leak slightly when the air end is perfectly tight. I will also state that it is very little used in the air cylinder. Some men never open the air cocks on the air cylinder at all. Most of them just run a swab around the piston once or twice a day.

The President. Are there any others who desire to speak on this subject? If so, there is now an opportunity.

Mr. T. B. Purves, Jr. Mr. President, I would say in regard to the mileage of packing, in looking over the record, the best I could find for

one set of piston rod packing was 120,000 miles. That, of course, is exceptional, because the packing was in that engine for about two years and three months. If we are enabled to get eight months' wear out of each set of piston or valve rod packing, we consider it a pretty good record. Now, if any who are interested in this matter will look over their stock-book or their storekeeper's book, or whatever book they keep those records in, they will undoubtedly find that a certain engine has been equipped with more piston or valve rod packing than it should have been, and if you take the trouble to look into that, you will find that there is a local cause for using so much packing. Engine-house foremen, I won't say all, but some of them, will take the quickest way to get at a job. For instance, if an engine comes in and the rod packing is reported, he takes it out and puts in a new set. Perhaps that set may not run a week, and comes in again in the same condition. He takes the old set out and puts a new set in. That is all wrong. There is some cause for that packing wearing out in so short a time, and if you can impress upon the mind of those who have charge of that work that there is a cause for this amount of packing being used in a certain engine and to look for the cause and find it, and remedy it, it will be a good thing. One may say the cost of packing, perhaps, does not amount to a great deal in a year, or does not increase the running repairs on a number of thousand miles; yet it is a little leak, and if we are enabled to stop these small leaks, it is surprising to see how the figures will drop on your total.

Mr. Gosselin. Mr. President, on our road we have an engine that ran fourteen months with metallic piston packing without being touched. It ran 124 miles a day on a regular train. I think that is a pretty good record.

The President. If there is nothing more to be said on this matter we will pass to the next subject before the Club, The Relative Value of the Different Types of Slide Valves, and I will ask Mr. Bartlett, of the Boston & Maine Railroad, to open the question.

Mr. H. Bartlett. Mr. President, I have no paper on this subject, and I have not had the time to give the subject that attention I should have liked, but perhaps I can say enough to start the discussion. You have, no doubt, all read the paper presented on the same subject by Mr. Pomeroy before the New York Railroad Club in December, in which Mr. Pomeroy described the different types of valves which have been used on locomotives. You are all familiar with the difficulties of the unbalanced valve in the locomotive service. The excessive pressure on the top of the valve consumed a great deal of the power to operate the engine, caused great wear on the valve seats, and wear and tear to the valve gear, and also made it difficult to reverse the engine. I think it

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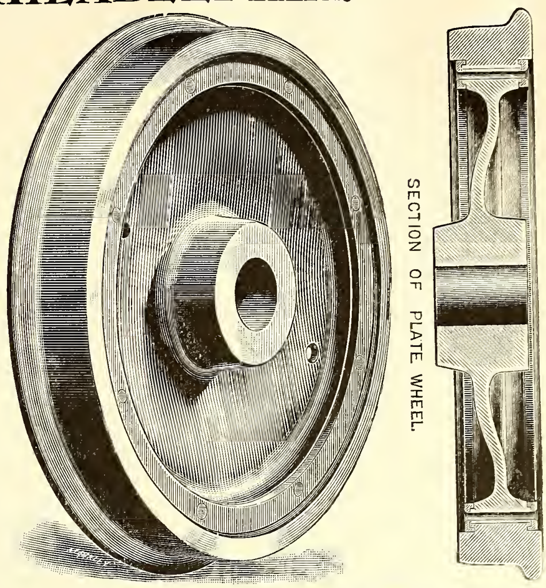

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has been said that an unbalanced valve has been known to wear as much as an eighth of an inch on a valve seat in a hundred miles. They are also said to have consumed as much as three to four per cent. of the power of the engine to move them alone.

Probably one of the greatest inventions for the benefit of locomotive service has been the balanced valve. The first balanced valve, I believe, was used as early as 1838 in England. I have forgotten just what the road was. The most common type of balanced valve known in this country is probably the Richardson valve. Some tests were made by the Chicago, Burlington & Quincy road in 1886 to determine the power required to move a balanced valve over that of the unbalanced valve, and as a result of these experiments it was shown that it took about thirty-six per cent. more power to operate the unbalanced valve than the balanced valve under the same steam pressure and the same lubrication, the per cent. of the valves that were balanced in this case being only about forty per cent. of the area, when, if they had been balanced up to the average of to-day of fifty-two per cent. of the area, the showing would have been even better. You all know the benefits of the balanced valve. The excessive pressure on the top of the valve has been removed; there is less wear on the valve seats, less wear upon the valve gear, and it is much easier to reverse the engine.

Of the other types of valves which have been used in locomotives, the piston valve may be mentioned. It has been used in different parts of the country on different roads, but I hardly think anywhere with absolute success. I believe the New England road had some engines a while ago with piston valves, but they were removed some time ago. The Chicago, Burlington & Quincy road has just received some new engines, I believe, which are equipped with piston valves. Just what these promise I do not know.

As to the difficulties with piston valves, I have never had experience with them, except on one engine. The troubles with piston valves, so far as I know, are in obtaining a full port opening, unless a valve of the plug-form type is used. Where packing rings are used with piston valves, as is usually the case in this country, bridges have to be used usually over the ports.

There is also difficulty with the rings staying down when covering the ports during compression, and also, further, there is trouble with piston valves thumping when steam is shut off, on account of their inability to relieve themselves by rising from the seat like a slide valve. On the whole, I am not able to find out that piston valves have anywhere been a success.

Of the other kinds of valves which are used quite extensively, may be mentioned the balanced valve with the Allen port. The chief point

of this valve, I believe, is the good admission which is claimed for it, there being twice the opening in the Allen valve that there is in the ordinary valve. The Allen valve, however, I understand, is better adapted to short travel and short cut-off, and therefore better suited to passenger service.

As to whether there is any decrease in the back pressure or fuel economy with the Allen port, I am not able to say. I trust there are some gentlemen here to-night from whom we shall hear on piston valves and the Allen port.

To sum the matter up, I will say I am rather in favor of the Allen port for passenger service. For freight service I doubt if there is anything better than the Richardson valve. Piston valves, I hardly think, up to this time promise very much for locomotive service, unless there is some particular object to be attained, as in the case of compound engines, where the boiler pressure is so high and there is difficulty in lubricating the slide valve.

The PRESIDENT. I think it was usual to put in a rubber valve. It is usual to put a Richardson balance on the Allen valve, is it not, Mr. Farmer?

Mr. FARMER. I think so.

Mr. JOHN MEDWAY. Mr. President, we have used the Richardson balanced valve on practically all the locomotives, and they have given excellent satisfaction. We consider them superior to the unbalanced valve, in that we have less wear and tear on the machinery, and also on the engineer. There is another reason why we are rather favorably disposed towards the Richardson valve. It was devised and perfected in our shop at Troy. Mr. Richardson was the machinist in that shop, and it was gotten up there and placed on the road, and as the result it has cost nothing for royalty.

With reference to the Allen valve my experience is somewhat limited. We have only had two passenger locomotives with the Allen valve. They are doing excellent service, but I am not quite sure that we want to go into the additional labor and expense of the Allen valve for the results we get from it. I think it is quite possible we get just about as good results from the ordinary Richardson valve without long ports.

The PRESIDENT. I will say that the Allen valve is quite a heavy valve necessarily. It has to be heavy enough to core that port over from one side to the other. My experience with the Allen valve was that you couldn't see enough difference between that and the common slide valve with Richardson's balance properly set, but we get just as good service without the Allen port as we do with it. The design of the Allen port was to get the additional amount of speed at the same point of steam entering the port, where you would get an opening. At

the first opening of your valve you get a simultaneous opening with the Allen port, which added to it, but over the eccentrics you get five and one half to three-quarters travel to an inch of lap of your valve set about line and line. At every stroke you get a good opening when you get up into working position, and you will get the same when it begins to open, and probably the valve is wide open when your engine has gotten about one-eighth higher stroke, before it gets the full benefit of the boiler pressure, all that can be had, where that does the most good, from the first eighth to the first quarter, toward the last eighth, when it is shut off. There was one engine in particular, a passenger engine, the seats of which were getting all cut up, and while we took a good deal of pains to get the sand out of that Allen port, at the same time we did not succeed in getting enough out to prevent its scraping, and I put in the common valve, and got as good work out of it as before, and was satisfied with it.

We will be glad to hear from Mr. Purves.

Mr. T. B. Purves, Jr. Mr. President, the majority of locomotives built in recent years have large ports, and carry high boiler pressures, and no one will admit for a moment that the balance slide valve is not a necessity; but there are some who do not think that the Allen port is a necessity. On our line we have sixty-two consolidation engines, and of that number I think there are thirty-six equipped with the Allen-Richardson valve. A careful scanning of the performance sheets shows no perceptible decrease in the cost of fuel of engines equipped with the Allen valve, over those equipped with the plain Richardson balance. If I remember rightly, it was in 1883, when I was located at Albany, I assisted the late F. W. Richardson, the patentee of the Richardson balanced valve, in making a series of tests on a Boston & Albany standard engine to determine the pull on the valve rod with his balance, and with a plain slide valve without his balance. If I remember rightly, there was about forty per cent. decrease. Of course, that forty per cent. decrease means a great saving, not only in the engineer, but also in the wear and tear of the different parts of the valve motion of your locomotive.

Mr. G. L. Fowler. Mr. President, I am not a member of the Club, but I have had a little experience in valves, which may be of some interest, and I think I can answer some of Mr. Bartlett's questions in regard to piston valves. There is nothing in the world requiring so much care and attention as the ordinary slide valve. I have had very successful and very disastrous experience with it. One of the disastrous experiences was a case where I was superintendent of the shop, and we were building a very large slide valve. The engine was in a saw-mill. Our general manager was a man of inventive capacity, and he imme-

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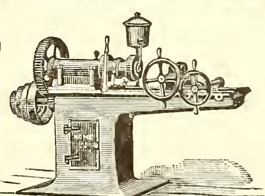

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diately decided he could build a balance to that valve, which he did with not very good results.

In the West on some steamboats they use a rocker valve very successfully. In fact, ten years ago it was almost impossible to convince an engineer on a western steamboat that anything else would operate an engine. They insisted on having a rocker valve, and they did work remarkably well, and worked for a very long time. The only trouble that was experienced was wearing the valve stem slightly, but by making a valve stem independent of the valve and putting it in a slot, we got over that difficulty.

Now, in regard to the plug valve, of course, it is absolutely impossible, as far as I know, to make plug valves without packing tight. We used to use it on some reversing engines for saw-mill purposes, where our plug valve was our reversing valve. By throwing it over in one direction, we took steam into the exhaust of our engine, thus reversing it. Of course, fuel was cheap, so we did not care for the expense. Some recent experiments on the London Northeastern road showed some remarkable results for the piston valve. I do not know whether the figures have been published in this country or not. But they looked when I first saw them as though they had been doctored, — as though they were not actually taken from ordinary piston valves.

Mr. Bartlett refers to the piston valves, that it is necessary to bridge over the ports, and that with the ordinary packing you really do not know where the point of cut-off is, but if you make it with a large valve, then you get a leakage back underneath the packing. If you make it so your packing leaks and your valve travels clear over the port, you have the same as any other, but there has recently been put upon the market an arrangement for packing which entirely overcomes that difficulty. If you will allow me to show you on the blackboard, I can show you how it is made. (The speaker then went to the blackboard and made a diagram which he explained.)

The President. We have with us to-night Mr. Shaw with a model of a valve motion which he has brought here to show. Perhaps Mr. Shaw will be willing to explain the model. There are some features of it that are new to me, and it may be of interest to others.

Mr. Shaw. Mr. President and gentlemen, speaking of valve motions and valves, I would simply say here before making a statement in relation to my valve motion, and specially referring to the Allen valve, if I understand the Allen valve rightly, it has a double admission, and as a result we get a full admission. We have a difficulty in the release of the Allen valve. If you got a double release it would be of some benefit. It seems to me there is no particular benefit from the Allen valve as now constructed, although as far as valves are concerned, there are

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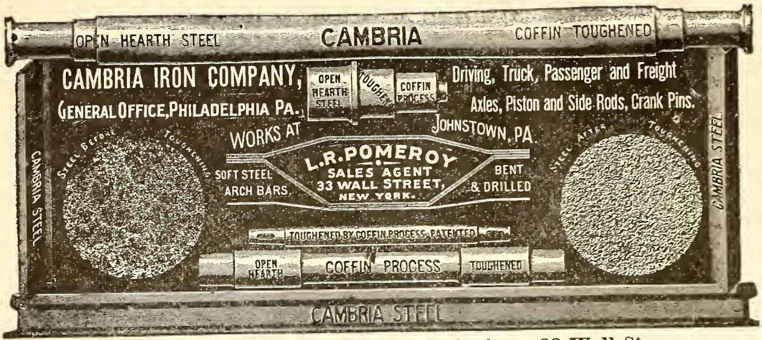
no better valves than the Richardson balanced valve as it stands to-day in practice. It seems to give as good satisfaction as anything, as far as I know, but I believe that the inefficiency of the valve is not due so much to the valve itself as it is to the valve motion, that which is behind the valve. I think the common slide valve has the proper motion as to slide, and I have a model which, of course, cannot be understood without being examined. I have given this valve motion some considerable study, and I have come to this conclusion, that no valve motion, however well constructed, can be efficient where one eccentric throws the lap of the valve and opens the port with the same set which is common to the valve of to-day, but there must be independent motion in order to get a quick opening at the proper time. In this valve motion that I have here this evening, I have this quick opening, opening at nearly double the speed of the ordinary valve. The cross-head is on the centre, and as it is turned here the port is thrown wide open. As I turn it you see that at the end of the stroke here the valve is wide open. There is a rest under the valve which allows the exhaust steam to pass out, giving a little time for it to pass out, and with that motion we can produce a valve which is much quicker in action. It has been said here, and it is said by all railroad men to-day, that, while we have been increasing the weight of our large engines, they are slow to start, sluggish; and that is true, from the fact that, while we have increased the weight of our engines, we have not changed the form of valve motion. In other words, we have not kept up the speed of our valve opening equal to the weight of our engines, and the result is we have slow moving engines. Now, it seems to me if the valve motion can be made so that this opening should become quick and instantaneous, we could make quicker moving engines for our heavy engines. I do not know how far I am to go, Mr. President.

The President. As long as you wish, Mr. Shaw.

Mr. Shaw. Well, that will take me until morning. Well, this is a rough, crude model, comparatively speaking, and if any gentlemen are interested, and will come up forward here, I can explain it to them. (Mr. Shaw then operated and explained in detail the principles illustrated by his model.)

The President. I see Mr. Lewis, of the Boston & Albany Railroad, in the hall, who is an expert on valve motion. We would be glad to hear from him.

Mr. Benj. Lewis. Our president spoke of the Allen valve not doing so well as the slide valve. The Allen valve cannot do as well as the ordinary slide valve on the common engine. The port has to be made to accommodate the Allen valve. I think Mr. Purves spoke of his test. He found that other ports were too narrow to accommodate the Allen



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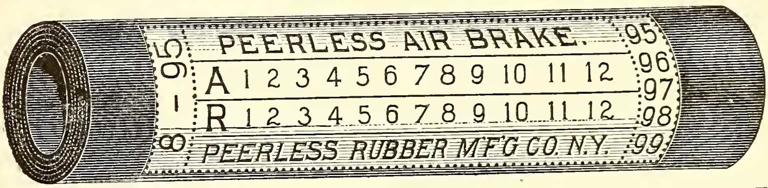

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valve. That was before I came on the road. To accommodate the Allen valve the ports have to be wide to allow for the clearance around the valve. Mr. Shaw spoke of his moving an inch and a quarter lap. As long as he had his seven-eighths lap, I cannot see what he gains by doing that. If the travel of the valve in proportion to the speed of the piston is the period of our expansion, so that an inch and a quarter is moved as quickly as seven-eighths, during the same movement of the piston, I cannot see that we have gained anything.

I do not know that I have anything more to say.

Mr. Shaw. I will say one word more in reply to Mr. Lewis. He said he did not see where I gained. What I gain is at the other end. By reference to this model, you see we have a more rapid movement, and throwing off the lap at the end of the stroke there is a rest there. I did not explain that perhaps fully.

Mr. Lewis. That is what I wanted to bring out.

Mr. Shaw. There is a rest there at the end of the stroke which allows the piston to move some six inches while the valve is entirely at rest. Now, the gain is on that end, and it allows the exhaust steam to pass out from it; in other words, to clear itself.

The President. We are ready to hear from anybody else who has something to say on this subject.

Mr. Fowler. Mr. President, I will say one word more in regard to the link motion, if I may be allowed. I think one reason for the difficulties which have been experienced in this matter, is that so many people have been endeavoring so long to do the work better, and is due to a great extent to the carelessness of designers in designing motion. For example, I know of a superintendent of motive power upon one of the roads in this country, who had some switching engines designed. It was at the time when standards were just beginning to come in, and he had a standard link upon a heavy passenger engine with eccentric rods some seven and one-half feet long. His switching engine had eccentric rods about three feet and six inches long. After he had arranged for a big link, when his draughtsman was laying out his valve motion he interfered with him, and said he would like this length of link, and an order came to put this link on. The draughtsman put it on and found that with his rocker on the length it was necessary to make it, his links would be dragging along on the pavements loosely; that is to say, the paving stones on the street would interfere with it, so he thought he would cut the ends of that link off, which he did. That was the link that was put on to the locomotive, and they were built on that design.

It was utterly impossible to get anything square.

Those engines were built and run for a long time. I do not know

whether the links have been changed now or not. I rather suspect that they have been, but any one who has ever worked at valve motion knows how exceedingly sensitive it is. I had a case some years ago. An engine came from a prominent builder, where it was utterly impossible to set the valve square, and we found the difficulty lay in the fact that it was desired to get the eccentric rod straight, so they had simply designed their valve motion, and then found the eccentric rod would strike the shaft and lift the shaft, and raise it up about six inches, throwing the valve out, so that nothing could be done with it, but we dropped it down into proper position, and the engine was perfectly square. You can take any single point in the valve motion, and if anything is out of shape the valve motion goes wrong, and it is simply because they will squirm and twist and something will give way, or cause more motion. That is one of the reasons why the link motion is so unsatisfactory at times; but you take a ring motion that is properly designed, so that the valve can be made to cut off square, — I do not mean exactly square, but as near square as the ring can be made, — it is a satisfactory motion, and it seems to me it is as cheap a motion as can be made. The valve motions that are using ports seem to have no particular advantage over it. It has an advantage to a certain extent, but the ordinary ring motion, I think, can be found, if properly designed, to be as economical motion as can be made.

Mr. Hutchins. Mr. President, the great trouble with the Richardson valve, from the practical standpoint, is that the balance strips are liable to leak, and I would like to ask somebody if they know of any really accurate way to determine which side they are leaking on without going into a careful research. It is a fact that the outside end strip of a valve drops down, I will say, nine times to one of any of the other strips, and we cannot tell, of course, which side it is on. The small hole down through the valve to carry that steam off is not large enough. It is only half an inch, and it creates a tremendous friction there, and it is a pretty hard matter to decide. Of course, it is a delicate matter for an engineer to go into a terminal and report valves blowing without being able to say which side it is on, and I have seen it occur very often that good engineers have reported the blow on the wrong side. After carefully looking into the matter, inquiring and discussing it among good practical men, I do not know of any practical way to determine which side a balance strip is leaking on, on the Richardson valve, and if there is anybody present who can give me information on that point, I should be pleased to have him do so.

The President. Is there anything further to be said on this question? If there is, there is now a brief opportunity.

Mr. H. Bartlett. Mr. President, I think there is one point further

in connection with valves that has not been dwelt upon very much, and that is the matter of lead. It used to be the supposition that in order to make an engine work smoothly you must have a certain amount of lead. That this is not true is pretty well known now everywhere. This is pretty well illustrated by the smooth riding of an engine shut off at high speed. If properly balanced, the engine probably runs as smoothly as ever it did in its existence. Ten years ago it was the practice to give an eighth of an inch lead. It has been gradually cut down to a sixteenth and a thirty-second, and in some cases to zero. This has resulted in great improvement to the engine. There is no doubt that lead has been very injurious to the operation of engines. It has caused probably more wear and tear to the valve gear, and more expense for repairs than anything else. I have no doubt the practice of throttling engines is attributable to a great extent to excessive lead. On some new engines which we have just designed, and which we are just receiving at the present time, we have given this a good deal of attention. These valves have five and three-quarters inches travel and one inch outside lap. We were very particular to see that these valves had only a thirty-second of an inch lead in the full gear forward, and only five-sixteenths inch lead at a quarter cut off. From further study of this matter, and since indicating these engines, I am confident we can go still further on this matter of reducing lead to advantage, and we are going to try some engines with the lead cut down to zero in full gear forward, and with one-quarter inch lead at quarter cut off. I am quite confident that is going to make still smarter engines than we have now, and will result in some economy of fuel, too.

Still another point which has not been spoken of this evening, is inside clearance on the back edge of the exhaust. You who are familiar with indicator diagrams know that the exhaust takes place at unequal points on the periphery of the wheel if the valves cut off equally back and front, due to the effect of angularity of the main rod. By advancing the exhaust on the back edge by the proper amount of clearance, the compression is equalized in both ends of the cylinder, and it is more easy to make the valves sound square.

These two points, I think, are very important, and as they have not been spoken of this evening, I thought it would be well to mention them.

Mr. Shaw. I should like to say one word in regard to this lead. I find this lead has led a great many men astray (*laughter*), and that, as has been said by some, we need the lead to stop the momentum.

I will ask any gentlemen here if there is any momentum when the engine is doing her work, when she is just balanced to her load? Is there any momentum in her connecting rods? Not a particle. That

is where, as I said in the beginning, it has led men astray; but talking of this lead, we do not want any lead on our engines, because it is on the wrong side of the piston, and when we have our piston with the steam on the right side of that, and none on the other, then we can have effective work.

Mr. T. B. Purves, Jr. Mr. President, inasmuch as we have quite a number of visiting gentlemen with us this evening, and I do not know how our caterer has come to time on the lunch question (but I presume there will be enough for all), I trust the members of the New England Railroad Club will kindly take back seats until the visiting brethren have obtained refreshments.

The meeting then adjourned. 9.50 P.M. 158 present.

NEW MEMBERS.

Bean, Wm. G., Union Station, Boston, Mass.
Bigelow, C. A., 4 Garfield St., Greenfield, Mass.
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Brewer, A., F. R.R. Co., Troy, N.Y.
Briggs, John, 31 Batterymarch St., Boston, Mass.
Chapman, Geo. B., Fitchburg, Mass.
Dole, Walter N., 133 Pearl St., Boston, Mass.
Ewart, John, B. & M. R.R., Boston, Mass.
Gibson, A. J., Southern Pacific Ry., Ogden, Utah.
Goodwin, Chas. E., B. & M. Car Shop, Lawrence, Mass.
Hall, Chas. S., B. & M. R.R., Boston, Mass.
Holt, A. C., Norton Iron Co., Everett, Mass.
Isbester, T., N. Y. Air Brake Co., Chicago, Ill.
Macdonald, F. T., B. & A. R.R., Boston, Mass.
Mitchell, Guy E., B. & M. R.R., Boston, Mass.
Pitkin, A. J., Supt. Schenectady Loco. Works, Schenectady, N.Y.
Prince, Albert E., 133 Pearl St., Boston, Mass.
Reynolds, S. T., F. R.R. Co., Williamstown, Mass.
Richards, Edw. N., P. O. Box 1006, Springfield, Mass.
Robinson, Henry C., Union Station, Boston, Mass.
Sague, James E., Schenectady Loco. Works, Schenectady, N.Y.
Sauer, P. O., Suite 1, Huntington House, Boston, Mass.
Shaw, Henry T., Corey St., West Roxbury, Mass.
Sherwin, Thomas E., B. & M. R.R., Boston, Mass.
Smith, Carl B., B. & M. R.R., Boston, Mass.
Whitham, John G., Signal Dept., B. & M. R.R., Boston, Mass.

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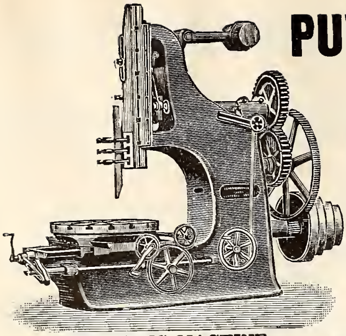
Sears, Edw. S., 68 and 70 Pearl St., Boston, Mass.

DROPPED.

Barrett, A. R., Boston, Mass.
Hoffman, B., Stockbridge, Mass.



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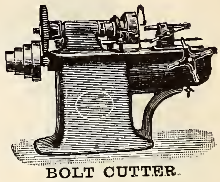

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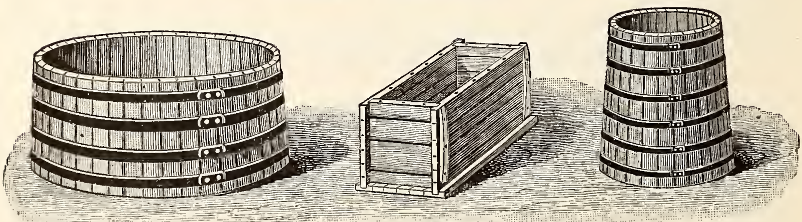

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Meeting of May 12th, 1896.

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Next Meeting, Tuesday, October 13, 1896.

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JOHN T. CHAMBERLAIN, President	"	1893,	"	1895.

PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, May 12, 1896.

The meeting was called to order shortly after 8 o'clock by the President, Mr. L. M. Butler, who stated that the minutes of the last meeting as printed in the report would stand approved, no objection being made. There were no committees to report, no unfinished business, and no new business to be brought before the Club.

The President. The appointment of committees is the next in order. I would say that this is the last meeting that we shall have before the convention. Our next gathering will be our annual social gathering in September, and I have appointed on the entertainment committee, F. E. Barnard, George H. Wightman, George Barber, C. W. Sherburne and E. L. Janes. I shall leave that business in their hands, and when the proper time comes we will all be notified what the programme is to be. We have some applications here to-night that have been before the Executive Committee and accepted. Our Secretary will read the names, some forty-one new members. There is also a letter to be read concerning the action which was taken upon the death of the Secretary of the New York Club, Mr. Watson. The Secretary will please read the letter.

The Secretary. I would say that this letter was received the day following the last meeting.

HAVERSTRAW, N. Y.,
April 13, 1896.

GENTLEMEN :—

By request of Mrs. Watson, I write you to express her appreciation of the kind action of the New England Railroad Club in presenting to her, through your committee, the beautiful memorial resolutions.

It is very gratifying indeed to know that others feel the loss which she has sustained.

Very truly yours,
J. B. STEWART.

Messrs. JOHN MEDWAY,
J. T. CHAMBERLAIN,
EDWARD L. JANES,
} *Committee.*

The applications of the following names have been acted upon by the Executive Committee, and the gentlemen have been elected members of this Club :—

Bailey, C. D., 120 Broadway, New York City.
Caldwell, E. M., Eastern Car Heater Co., 50 State St., Boston, Mass.
Chamberlain, James W., Engineer, B. & A. R.R., Dorchester, Mass.
Crane, Thos. H., Foreman, Fitchburg R.R., Fitchburg, Mass.
Cutting, W. J., R. H. Foreman, N. Y., N. H. & H. R.R., Worcester, Mass.
Dane, Albert P., Foreman Painter, B. & M. R.R., Boston, Mass.
Eaton, Fred H., Pres., Jackson & Woodin Mfg. Co., Berwick, Pa.
Evans, H. W., Foreman, Keene, N.H.
Ewing, William D., Gen'l Supt., Fitchburg R.R., Boston, Mass.
Freeman, Henry N., R. H. Foreman, B. & A. R.R., Boston, Mass.
Greenwood, H. A., Foreman Inspector, Fitchburg R.R., Fitchburg, Mass.
Hough, E. W., H. W. Johns Mfg. Co., 119 Federal St., Boston, Mass.
Hutchinson, C. B., Inspector, B. & M. R.R., Lowell, Mass.
Lord, G. W., Foreman Painter, Fitchburg R.R., Fitchburg, Mass.
Lynam, John S., Signal Dept., B. & M. R.R., Boston, Mass.
McKibbin, C. H., 120 Broadway, New York City.
Mooney, W. R., Train Master, Concord, N.H.
Morrill, Ephraim, Foreman, B. & M. R.R., Lawrence, Mass.
Morrill, Fred H., Machinist, Fitchburg R.R., East Fitchburg, Mass.
Murray, Daniel, N. E. R.R., East Hartford, Conn.
Page, Adna A., Foreman Carpenter, B. & M. R.R., Boston, Mass.
Paige, Chas. E., Thorndike St., Lowell, Mass.
Patterson, Andrew, Tinsmith, B. & M. R.R., South Lawrence, Mass.
Patterson, S. F., Supt. Bdgs. and Blds., B. & M. R.R., Concord, N.H.
Perham, Alonzo L., 40 Salem St., Woburn, Mass.
Prescott, Emerson B., 183 West Brookline St., Boston, Mass.
Putnam, Chas. H., Putnam Machine Co., Fitchburg, Mass.
Richards, Robt., Gen'l Foreman, N. E. R.R., 21 Puritan Ave., [Dorchester, Mass.
Robbins, Milton, Fitchburg R.R., Fitchburg, Mass.

Robertson, A., Train Master, Fitchburg R.R., Union Station, Boston.
Rockett, E. J., Blakeville St., Dorchester, Mass.
Scott, Walter M., Clerk, B. & M. R.R. Shops, Boston, Mass.
Smith, Edw. A., Supt. Tel., Fitchburg R.R., Boston, Mass.
Staddleman, W. A., Havemeyer Building, New York City.
Steele, Robt. J., M. P. Dept., N. Y., N. H. & H. R.R., Roxbury, Mass.
Stone, C. T., Station Agent, B. & M. R.R., Lawrence, Mass.
Sullivan, John, Yardmaster, B. &. A. R.R., Boston, Mass.
Tait, John, N. E. R.R., 113 Beacon St., Worcester, Mass.
Walton, Eben A., R. H. Foreman, Fitchburg R.R., Charlestown, Mass.
Weir, Wm. H., Centre St., Roslindale, Mass.
Wesley, Geo. W., N. E. R.R., Norwood Central, Mass.

The President. The subject to-night for discussion is "The Tonnage Rating of Locomotives and its Effect on Fuel Consumption." On this subject we will hear from Mr. Medway, Superintendent of Motive Power of the Fitchburg Road.

THE TONNAGE RATING OF FREIGHT LOCOMOTIVES AND ITS EFFECT UPON FUEL CONSUMPTION.

By Mr. John Medway.

That misleading and deservedly much abused document, the average performance sheet, is responsible for an occasional impression that in the matter of locomotive fuel economy we are gradually losing ground.

What are the facts in the premises? During the past few years, for obviously good business reasons, locomotives have grown in weight and hauling capacity two-fold; their burdens have similarly increased and their appetites have developed in like ratio. The speed of freight trains has increased generally about 25 per cent. and in some cases 50 per cent. From a mechanical standpoint this last condition may seem simply ruinous, involving, as it does, serious wear and tear on the locomotive and track, and an increased fuel consumption, in our experience, to the extent of 31 per cent.

Taking a broader view of the matter, it is a commercial necessity, and in these times of sharp competition, railways must, to some extent, cater to the demands of an exacting public.

The fuel account is adversely affected in no small degree by the prevailing system of rating freight locomotives on a car unit basis, a most uncertain factor when we consider that the car capacity ranges from ten to forty tons. Hence we find that locomotives are often overloaded and sometimes underloaded.

Several months ago, in connection with our general superintendent, we made a series of tests over a course of forty-one miles, embracing the maximum grade of the Western division, when the fact was clearly demonstrated that, ignoring the wear and tear to locomotives and track, the aforesaid extremes in loading are unprofitable, and that the best economy is shown in connection with a good, plump load with which the locomotive can readily climb the grade.

The tests also showed the relative economy of three classes of locomotives with which we had been hauling freight, namely: —

No. 1. Moguls, 19x26 in.

No. 2. Moguls, 18x24 in.

No. 3. Eight-wheel American type engines, with 17x24 in. cylinders.

The relative hauling capacity was: No. 1 over No. 2, 30 per cent.; No. 2 over No. 3, 46 per cent.; No. 1 over No. 3, 90 per cent.

The comparative coal consumption in pounds coal per ton of load was: No. 1, 33 per cent. less than No. 2; No. 2, 23 per cent. less than No. 3; and No. 1, 50 per cent. less than No. 3.

The total locomotive expense per ton of load was: No. 1, 1.3c.; No. 2, 1.8c. and No. 3, 2.3c.

Relatively the expense per ton of load was: No. 1, 28 per cent. less than No. 2; No. 2, 22 per cent. less than No. 3; and No. 1, 43 per cent. less than No. 3.

We may mention that at the present time the large Mogul is our standard freight locomotive and the eight-wheeler has been eliminated from this class of service.

Thus, the tonnage rating suggested itself as a solution of the loading problem. Our next step was to weigh the cars of several trains when it was found that the actual weights agreed approximately with those shown by the way-bills. It was then arranged that certain trains should be made up on the basis of the way-bill weights, plus the stenciled weights of cars. The results were a greater average tonnage per train, reduced coal consumption, less wear and tear of locomotive, and fewer cases of "stalling" on the grades, with the accompanying delays to other trains.

We have lately extended this system of loading to all freight trains as far as practicable; obviously we cannot conveniently include local, "pick up," and certain branch trains.

On railroads where a large proportion of the total mileage is made by freight trains, the gradients are heavy and the coal mines at a considerable distance, the item of fuel covers at least one-half the total cost of the maintenance and operation of locomotives. Just these conditions confront some of us in New England; hence it is of paramount importance that, for a given amount of work performed, we reduce the consumption of coal to the lowest possible limit.

Fitchburg Railroad.

Relative efficiency and economy of 19 in. x 26 in. Moguls, 18 in. x 24 in. Moguls, and 17 in. x 24 in. 8-wheel locomotives in freight service. Run of 41 miles over maximum grade of the Western Division.

Class.	Type.	Cylinders.	Diameter of Driving Wheels.	Weight.		Rating in Tons.	Relative Hauling Capacity.	Pounds Coal per Ton of Load.	Comparative Coal Consumption.	Total Locomotive Expense per Ton of Load.	Relative Locomotive Expense per Ton of Load.
				Driver's.	Total.						
1	Mogul.	19 in. x 26 in.	63 in.	114,000	130,500	950	No. 1 over No. 2, 30 per cent.	7.8	No. 1 less than No. 2, 33 per cent.	0.013	No. 1 less than No. 2, 28 per cent.
2	Mogul.	18 in. x 24 in.	57 in.	72,940	85,240	730	No. 2 over No. 3, 46 per cent.	11.7	No. 2 less than No. 3, 23 per cent.	0.018	No. 2 less than No. 3, 22 per cent.
3	8-Wh.	17 in. x 24 in.	63 in.	48,000	75,000	500	No. 1 over No. 3, 90 per cent.	15.3	No. 1 less than No. 3, 50 per cent.	0.023	No. 1 less than No. 3, 43 per cent.

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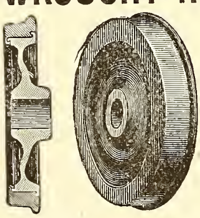

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The knuckle may be thrown open for coupling by the hand rod at the side of the car, rendering it unnecessary for trainmen to go between the cars to open the knuckle.

We have read with much interest and, we hope, some profit, the able discourse of Mr. J. N. Barr, delivered before the brethren of the Western Railway Club, on the familiar text "The Ninety and Nine." The beautiful pastoral story served to illustrate certain phases of railway experience, and the gentleman of reverence pointed out the folly of leaving the railway flock in the wilderness to the mercy of the wind and wolves, that the shepherd may bring the solitary wanderer back to the fold.

The analogy is finely drawn and the moral well pointed; but, Mr. President and gentlemen, if your recalcitrant renegade be a black sheep of the genus "carbonum," hunt him at once, take him by the horns, guide him safely back to the fold, give him special attention, let no mercenary outsider play tricks with him, personally conduct his training, and see that on the calorimeter grill his performance approximates the following points: Moisture, 1 per cent.; volatile matter, 23 per cent.; fixed carbon, 73 per cent.; ash, 2 per cent.; sulphur, 1 per cent.

Thus may a lasting attachment be found between the sheep and his master, who will feel fully compensated for his temporary diversion from the "Ninety and Nine."

It may not be uninteresting to mention the manner in which we have endeavored to control the dusky member of the Fitchburg fold. The making up of freight trains on a tonnage basis made possible the adoption of an individual coal account with the enginemen, based on the number of pounds of coal consumed per ton of load hauled. A suitable form was furnished the division superintendents, who supply the following information in connection with such trains as were designated by the general superintendent: Train number, locomotive number, name of the engineman, extent of run and weight of train. These are forwarded daily to our office, where the report is completed by the addition of the total number of pounds of coal consumed and pounds of coal used per ton of load during the trip.

We personally scrutinize these reports and forward them with our criticisms to the Road Foreman of Locomotives, who gives each specified case proper attention, not forgetting a word of commendation to those who make particularly good records.

It is interesting and somewhat surprising to note the wide diversity of scores made under apparently similar conditions. Prompt investigation frequently reveals the cause of a bad fuel record, and it is fair to say that it is sometimes beyond the control of the engineman; possibly a load of inferior coal, slippery rail, "stalled on the hill," helped train ahead, local work, or an engine failure. Of course the latter condition is occasionally aggravated by a sin of omission on the part of the engineman. We have found cases wherein locomotives have made several expensive runs, wasting, perhaps, two tons or more of coal each trip, when proper search

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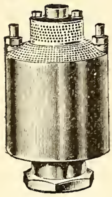

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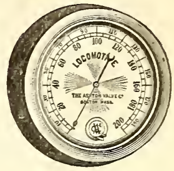

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Form 1210.

FITCHBURG RAILROAD COMPANY.

Fuel Record of Freight Locomotives on .... *Date* *198*

Division Superintendents will see that these Reports are made Daily, covering such runs as may be designated from time to time by the General Superintendent, and forwarded to the Superintendent of Motive Power for completion.

NUMBER OF		NAME OF ENGINEMAN.	RUN.		Coal Used in Pounds.	Weight of Cars and Contents in Tons (2,000 Lbs.).	POUNDS COAL USED.	
Train.	Locomotive.		From.	To.			Per Train Mile.	Per Ton of Load.

has located a mechanical disorder which formerly might have been ignored, so long as the locomotive did fairly good work.

Under the new order of things the engineman is on the alert for all causes detrimental to good, economical service. In this connection the fireman receives proper attention at the hands of the engineman, who, perhaps, for the first time, assumes a positive control of the entire locomotive outfit.

Admitting the possibility of the best men to make an occasional bad run, the same is not adversely recorded, but should a man make a succession of bad performances, the case is marked for drastic treatment.

In order to determine the quantity of coal consumed per trip, the coal tickets, which are of the usual book form with stub and coupon, were made to show the amount of coal found on tender, as well as the added supply. In computing the quantity used for a stated trip, the amount found on tender, plus that delivered at all points, less the quantity left over at the end of the trip, is charged against the engineman. Positive accuracy in the last item is desirable, though not readily attainable ; but to enable the coal charger to estimate the quantity of coal found on the tender, a vertical scale of half-ton spaces is placed in white paint on the tank, at the front end of coal space ; this insures a fair degree of accuracy.

Form 503. 2-15-96-500b-D. Co

FITCHBURG RAILROAD CO.

Date..............................189

COAL. *Engine No*......................

Weight found on tender....................*lbs.*

Weight furnished..............................*lbs.*

Engineman......................................

Delivered by....................................

At...

FITCHBURG RAILROAD CO.

Date..............................189

COAL. *Engine No*......................

Weight found on tender....................*lbs.*

Weight furnished..............................*lbs.*

Engineman......................................

Delivered by....................................

At...

We prepare and post monthly a list of the individual general averages of pounds coal per ton of load. This is intensely interesting to all concerned and provokes a sharp rivalry on the part of the men.

In order to demonstrate more clearly than ever the possibilities in the direction of either economy or extravagance, and to show the relative value to the company of careful, economical men, as against those who

have proved themselves unprofitable, we supplement the circular with a comparison of the extreme scores, reduced to a basis, which appeals most forcibly to the reasoning faculties of the average mortal — that of dollars and cents. For example, we quote from the April report: "Comparing the worst with the best individual general average of this division, and preserving the same ratio for a month of 25 days, we find in this single instance a possible loss to this company of $202.76."

We endeavor to show our appreciation of the efforts of the many successful men, and on the other hand spur to greater exertions the less fortunate ones; while the few continuously unprofitable men are informed that a prompt and radical change is necessary to justify the continuance of their services.

Incidentally, we may mention that we have also applied the personal coal account to passenger locomotives, using instead of the tonnage basis the number of pounds of coal consumed per car per mile and trip.

In connection with a bad fuel record the excuse is sometimes given that unusually fast time had been required; under such circumstances an increased consumption of fuel is justifiable, but it is a matter of record that the men who make the best average speed do not necessarily consume the most fuel. Such men have learned that it is expensive folly to overcrowd either the furnace or the cylinders.

An important factor in fuel consumption and locomotive repairs is the slipping of driving-wheels. Some men seem to gauge the speed of the locomotive by the revolving speed of the driving-wheels, regardless of the amount of slipping, and appear to be oblivious of the fact that thereby they may actually retard the momentum of the train. Josh Billings once philosophized thus: "Ef yer would get thar quick, go slow." Never was this truism more fully exemplified than in connection with the above particular phase of railroad service. If we were to pay our enginemen according to the number of revolutions of the driving-wheels, the poorest man, mechanically, may become a veritable Crœsus, financially, — all at the expense of speed, fuel, fireman, machinery and track. We cannot afford to pay any such premium on incompetency. On the other hand, may we not seriously reflect as to the extent to which *we* subscribe to the above evil, when we design and use driving-wheels which are too small proportionately to the size of the cylinders? In this relation we may say that our consolidation engines having the smallest wheels show the greatest expense in fuel and repairs, while the Moguls, with sixty-three inches diameter, give the best results.

Mr. President and gentlemen, I trust that in thus entering so largely into the details of the subject for discussion I have succeeded in elucidating the fact that, by simple methods and with such facilities as are readily procurable on most railways, the potent factors, tonnage

rating and fuel consumption, may be happily and profitably associated, so that at one and the same time the movement of traffic may be facilitated and the expense of transportation be materially reduced.

Mr. H. Bartlett. Mr. President, I would like to ask Mr. Medway if he will give us an idea of some of the weights of trains and pounds of coal per ton hauled on the different divisions that he speaks of.

Mr. Medway. Mr. President, we have quite a diversity of conditions on our railroad, physical conditions, and consequently the rates are not given according to the different divisions. I will say I have a table here that may be incorporated in our report, if you like, which will show those things. The hauling capacity of the large engines, 19x26, is 956 tons. That is over our Western division, forty-one miles, embracing a maximum grade of thirty-five feet per mile. The hauling capacity of the small Mogul engines was 730 tons, and that of the small eight-wheel engines, 500 tons. On the Tunnel division we haul rather less than that. I believe from Williamstown to Fitchburg the maximum haul is 750 tons.

The President. I take it that was the same rate of speed for each train?

Mr. Medway. Yes, for the ordinary freight train.

Mr. Bartlett. At fifteen miles an hour?

Mr. Medway. No, twenty.

The President. The question is open for discussion. Perhaps Mr. Bartlett has something he wishes to bring before the Club.

Mr. Bartlett. Mr. President, I feel a little new in this business. I came here to get points rather than to say much.

The President. It does not make any difference, Mr. Bartlett; we would like to hear from you.

Mr. Bartlett. We have only a couple of months ago taken up this subject. We have attempted some experiments on this line. We have just received some eight-wheel engines, sixty-two-inch drivers, weighing about sixty-three or sixty-four tons. We made a test last Sunday on the Western division with fifty loaded freight cars, which were hauled from Portland to Boston in about seven hours and fifteen minutes actual time. The total weight of the train was 1,257 tons; the net tonnage of the train was 685 tons. They used on that train 10,600 pounds of coal. The mileage is 114 miles, making an average of 2.02 pounds of coal per mile. The steepest grade on the Eastern division is about fifty feet to a mile; probably it is 4 miles long. We have been able to make a showing of that kind with eight-wheeled engines having sixty-two-inch drivers. We also made a few days before that a similar test on the Eastern division. We have hauled there with the same engine a train weighing 1,313 tons, fifty loaded cars, of which

598 tons was freight and the rest was car weight. In that train we averaged about 2.6 pounds of coal per mile. I have not got the figures exactly. I hope we shall get a little further in this matter pretty soon, and be able to talk more seriously from the coal standpoint. We are simply getting the rating of our engines now.

There is one matter that has an important bearing on this subject, and that is, to get as much tonnage as possible in each car. On many roads to-day, as you know, it is the practice to not load the cars up to their full capacity. I think the Pennsylvania Railroad to-day gives more attention to the matter of the transfer station and reloading their cars than any other road, perhaps, in the country; that is to say, the cars are loaded nearer their full capacity than perhaps anywhere else. This is a matter, I think, that has not been gone into as extensively as it might be in New England; and, of course, you are quite well aware that the same number of tons can be hauled in a few cars cheaper than it can be in twice the number of cars. This is an important point, and I would like to bring out from Mr. Medway whether they have practiced that on the Fitchburg Road, — whether you load up your cars more uniformly with greater tonnage than they did before this tonnage matter was taken up.

Mr. Medway. Mr. President, we find our cars are loaded more uniformly than they were before, full as heavy on the average; but we are not overloaded as much as we are underloaded.

Mr. Bartlett. What do you find to be the average tonnage per car?

Mr. Medway. Oh, I cannot say as to that, Mr. Bartlett. I have got from the superintendent the total weight of the train without the number of cars.

The President. There is an opportunity for any one who has anything to say on this subject, to say it. It is a subject which has a wide range, and there is a great deal which might be said upon it. If anybody can state what experience he has had in the matter, even if not a very large experience, all these little things will help to make up a complete whole.

Mr. E. G. Desoe. Mr. President, I would like to ask Mr. Medway if I understood him correctly, that on their mountain division, on the division where their heavy grades are, the Mogul engine is more economical than the consolidation engine with small wheels?

Mr. Medway. Yes, we do find that.

Mr. Bartlett. Mr. President, how is it on the New York & New Haven Road?

The President. I have no data to speak from, but we have some consolidation engines, and those engines are pulling fifty-car trains; but some pull more and some less. It is intended to pull fifty loaded cars

per train. I do not suppose all the cars are fully loaded. I know a great many cars are loaded with light loads, and two cars would probably take all that is put in five. That has been my observation. Of course, in this case we are pulling a good deal of dead weight over the road, which is justifiable if the cars are properly loaded to their full capacity. When I say that those engines are doing good service the way we are running them now, I can only say that from observation. The statistics and all that which relates to fuel consumption and car mileage are in the New Haven office, and those I have not obtained. I know, since they have confined those engines to a twenty-mile an hour limit, that their service has been much better than it was when they were running them at a higher rate of speed; and it has resulted, without a doubt, in a good deal of economy by so doing. There was a time when they were running those engines about as fast as they could run them. The speed was an unknown quantity, the only idea being to get to their destination, and get there quickly. My experience with engine movements and pulling trains has been that a small wheel means changing your cylinder a good deal oftener than with a medium wheel; and it costs money to change that cylinder. I have never been in favor of carrying local freight with anything less than the ordinary five-feet wheel, that would be from sixty-two to sixty-three inches. My experience is that there is more economy with a good-sized wheel. We do just as good service with it, and it has its effect on our long pulls. I am not in favor of small wheels unless you are going to run them at a slow speed, much slower speed than we run freight trains nowadays. I know this, particularly from the extra trains run on the Worcester division, which are not confined to any schedule. They start them out, and they want to get them there, and get them there quickly, and if they do not get there as quickly as the despatcher thinks they ought to, then there is a complaint that the engine has failed in its duty. Sometimes they want to run them at a passenger train rate, regardless of consequences. That costs money, too, and it all goes to the coal pile. The coal is quite an important factor in locomotive performance. There are a good many things that go to encroach on the coal pile pretty seriously, or, in other words, that amount to throwing away money. There are a good many bearings to this question. There are a good many branches to be considered, and they ought to be discussed. Probably there are a good many here with us to-night who have had more or less experience, and I would be glad to hear from them. I see Prof. Allen, of the Institute of Technology, present. Perhaps he will say something about the combustion of fuel from the scientific point of view. If he has anything to say we should be glad to hear him. (*Applause.*)

Prof. C. F. Allen. I am sorry that I was not here to listen to all of

the paper. It is an interesting subject, and it is an interesting paper on the subject. It seems to me that the importance of having such paying loads on your train is evident. Starting at my end of the line, as an engineer, we consider that it is very important, in the first place, that the grade on a line should be arranged so that we may pull as heavy a load as possible over the division, and an engineer is willing to spend a good deal of money in the first cost so that he may save the cost of operating. He is willing to spend a great deal of money so that a road can be operated economically, and then the next thing comes to operate it economically. We do not get at the truth of matters all at once in anything, and in railroading they have been making one improvement after another; and the progress that has been made in railroad work in this country, in the way of reducing the cost of hauling freight, is most astounding. It is very satisfactory and very creditable, and I do not think that any of us ought to feel very badly if there is something left for us to do in the way of making improvement. One of the improvements that seems to be going on now is to increase the tonnage of the trains, and it seems to me that it is entirely in the right direction. The point that was mentioned about getting such paying load as you can into a car means, of course, hauling more paying freight in a train, and for a given business it means hauling it in fewer trains; and when you cut down the number of trains you get very great economy. It seems to me if the expense attending the work of securing the result is considerable, that the saving that finally results from it will more than justify the expenditure of securing the carrying out of the necessary details. I believe in it very fully, believe in it very thoroughly, and whatever action is taken so that the engineers and firemen, and all the men who have to do the work, will understand that the work they do is being looked after, is work in the right direction.

I believe that one of the greatest things possible in the way of railroad management, — I do not care whether it is running trains or whether it is carrying on the finances, or whether it is treating stockholders right, or whatever it may be, — I believe one of the greatest things to be gained in railroad work, from beginning to end, is full publicity, bringing everything squarely into the light of day. I believe that it is a thing that we need more than anything else. I believe we need that quite as much as pools, and I have always thought that one of the important functions of the Interstate Commerce Commission when it was organized, or one of the valuable features of it, was that it required publicity in a great many ways. When you know what is going on, there is some chance to get things right.

I do not know that I am ready to discuss the details of this matter. It seems to me if you can increase the paying load that you take on

your train, the slight increase in fuel that may come from it is a minor consideration. Of course, it is desirable that the cost of fuel should be kept down as low as possible. It is desirable it should be kept down as low as possible whether you increase the weight of the paying load or not. It seems to me each thing stands on its own basis, although when you are at work upon one improvement it is sometimes possible to carry three or four others along with it. If you can do that, it is very good. I believe that the subject of the meeting is a tremendously important one, and at some inconvenience to myself I have made it a point to be here, because I wanted to get all there was out of it.

The President. Some members here in the car department may be able to add something to the subject by telling their observations about the transit of their trains, and the proportions of cars that are fully loaded in such trains. All those points have an important bearing on the subject, so that I hope that those men who are in the car department won't hesitate to make any statements here of their observations that may occur to them, because there are no doubt cases where there have been trains of from forty to fifty cars taken over the road, or probably thirty-five cars, and it has been done easily. Any observations, as I stated before, that any car department men have made any note of will be important, and we would like to hear from any of them. Mr. Marden, perhaps, has made observations. We would like to hear from Mr. Marden.

Mr. J. W. Marden. Mr. President and gentlemen, I thought that the car department was going to have an easy time; but there is no doubt that this question will bear discussion from the car builder's point. I think that any of you who have observed a freight train in the yard, starting from one end of it and going to the other, will bear me out in the statement that in almost every train, if the running gear could be put in first-class order, there would be a great saving in the coal pile.

Mr. Medway. I thank you.

Mr. Marden. I do not think there is a train that goes out of our yard, I do not think there is a freight train that goes out of any road's yard, but that you will find more or less of the cars will have the brake-shoes dragging on the wheel, either on the upper end or lower end of the shoes; and our journal bearings and our oil boxes, I was almost going to say, were a disgrace to a mechanic, who professes to be a mechanic; but we cannot help ourselves very well, because of the interchange of freight cars with each other. If, for instance, the Fitchburg or Boston & Maine should put on an improved balance roller bearing or an oil-tight box, or, in fact, any mechanical improvement in that direction, perhaps as long as they kept it on their own line it would be taken care of; but the moment it went on to other roads, the chances

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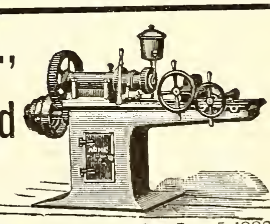

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are it would not be taken care of. I do not say that we would take care of appliances of that kind any better than our neighbor's road; but that is one of the great hindrances to making improvements in that direction. I think that the time will come when better mechanical appliances will be used in the shape of oil boxes and journal bearings than we have got to-day, and that will help reduce consumption.

Then there is another thing that represents increase of coal consumption. You go through any of our freight yards, in the winter time especially, and it applies proportionately in the summer time, and you will find that the lubricating oil is perhaps frozen solid, and it will take a great deal more power to start the train than it would if the proper lubricant was used and the cars properly oiled. It is wonderful that we can move our trains over the road sometimes. I do not say we are in any better condition than our neighbors. It is one of those things that will bear a great improvement. It has been given a great deal of study and thought, but we have not got there yet.

As a matter of fact, in the loading of cars some number of years ago, the Fitchburg road realized the importance of carrying full loads, and with that end in view built a transfer platform at Rotterdam Junction and one at Mechanicsville, and they have one at Bellows Falls, intending to carry, as far as possible, full car loads; and that has been given a great deal of attention by the transportation department. But there is one other thing that we lose I will speak of, in making cars to carry heavy loads. I think that the dead weight, the weight of freight cars, is increased about one-third, perhaps a little more, according to the framing, the size of the timber, etc., such as is used by the different roads in making 40,000 and 60,000 pounds cars. You take a 60,000 pounds box car, and I do not think that you will find on any road the average will be twelve tons of freight that will be carried in the 60,000 pounds box car. Of course, in the matter of grain and any merchandise that you can get 60,000 pounds of into the car, there is economy in so doing, and that lessens the number of your cars in the train; but I think you will find that statistics will show there has been an increase of the dead weight to-day as carried in our cars, rather than a decrease, from the fact that on general merchandise it is impossible to get 60,000 pounds or even 40,000 pounds in a box car.

I can only add that I think this question, while it is more interesting, perhaps, to the locomotive department, yet it is one of those in which the car department can help a great deal in the reduction of the coal consumption.

Mr. Desoe. Mr. President, I can describe, perhaps, what will be of some interest in regard to brake-shoes on trains. Mr. Marden's remarks brought it to mind. Some time ago I was on a freight train


A. C. RUSSELL

going from Worcester to Boston. This was a train of forty cars, and starting out of the Worcester yard we had quite a steep grade, about forty feet to a mile, I think it is, for about one mile. We started and got about half way up and then had to stop, not on account of want of steam or of a poor rail, but the engine had more than she could pull — overloaded. We backed back into the yard, and had to wait there some time for a passenger train. I went over the entire train with two men and pulled the connections away from the wheel so that the shoes did not rub against the wheel on any car. Now, that same engine took that same train up that grade without any trouble at all, and went up at a good rate of speed. It was the same train and the same engine. The only difference was the shoes were not bearing against the wheels.

Now, in regard to locomotives and lubricants becoming stiff in the boxes. Several years ago when I was running an engine, one extremely cold night, after pulling a train of thirty cars with a consolidation engine up a sixty-feet grade, we backed on a turnout having a grade of about thirty-six feet per mile, to wait for a passenger train. I staid there two hours, and I couldn't take that train up that thirty-six feet grade, and I had to leave four cars that we had just pulled up a grade of sixty feet to the mile. The only way I could account for it was simply the lubricant had become stiff in the boxes.

Mr. Elmer H. Morse. Mr. President, you asked that something might be said from the transportation department. I have read quite a little lately on the subject of having our freight trains haul a full load at all times. I was very much pleased to learn from Mr. Medway that they had a system there of grading their trains by weight. I would like to ask him at their junction points how they get at that, whether they go by the weight of the cars, and whether the engines are rated at so many pounds.

Mr. Medway. Mr. President, it is based on the way-bills, and from the stencil weight of the cars.

Mr. Morse. Are the engines rated by the transportation department by a regular rating of the engines so as to be governed in their movements?

Mr. Medway. Yes, they are. Of course, much is left to the good judgment of the yardmaster as to making up the trains, in regard to the state of the weather, etc.

The President. Graded by tonnage, is it not?

Mr. Medway. Yes, sir.

The President. I hope other gentlemen will avail themselves of the opportunity to speak.

Mr. Henry Shaw. Mr. President, I would like to say one word in relation to slipping of the shoes of locomotive driving-wheels. I go

back to our first starting point, not that I have had any experience in railroading, but from a mechanical standpoint I would like to say one word. I think it is desirable to look out for the locomotives. I do not care what the cylinder power is of our locomotives. If you develop a million horse-power, all we can use is what can be put through the driving-wheels, the point of contact of the driving-wheel with the rail. It seems to me that it is absolutely necessary in the construction of our locomotives to get them so well built and balanced that we have no rolling movement. A good many of our locomotives have a rolling movement in running at a rapid rate of speed, and as soon as they commence rolling they let go of their hold on the rail, and we lose the cylinder power or the cylinder full of steam, and the result is we have less effective work. If we will construct our locomotives so that they will continuously hold to the rail, we can have more effective work with less cylinder power.

Mr. Medway. Mr. President, this matter of economy is something in which we are all interested, and I hope the subject will be fully ventilated. Few roads have money to burn. It is a fact, nevertheless, that almost all roads have been burning good money, good thousand-dollar bills; and who is responsible for this extravagance? Answering my own question, I will say nearly every department of the service. Hence I hope that each department will be fully represented in this discussion. With a full co-operation of the various departments, I believe a system could be adopted whereby ten per cent., or certainly five per cent., of our coal bill may be saved. You may think of it for yourselves, gentlemen, what that would amount to on your respective roads, a saving of five per cent. On the road with which I am connected it means $35,000 per year, an item well worth struggling for.

The President. That is true, Mr. Medway.

Mr. Medway. Mr. President, I want to say one word, before I sit down, in relation to oil. I think that has a bearing on the coal pile, and we are burning up a good deal of the coal in the use of poor oil. I believe that a road will make no mistake by the use of the very best of lubricating oils, both on engines and on cars, not only in the matter of helping the coal bill out, but I think if it is carefully used that it will be cheaper in dollars and cents to use a rich lubricating oil of good value than it will to use a poor lubricating oil that is full of tar and, as has been said, freezes up and blocks the wheels. I think that is a matter that ought to have serious consideration from the different roads. The tendency has been, I know from experience, to get oil just as cheap as you can possibly buy it.

Prof. Allen. Mr. President, I would like to say another word. It seems to me that in considering this question we ought to look not

merely at the saving in coal on the run of a given train. If Mr. Marden is able by better lubricants, and by looking after his brake-shoes, and by taking care in various ways, to relieve the engine of work (and, of course, one way of looking at it is that a run is made with less coal, and that is a good way of looking at it, because there is economy from it), but there is another way of looking at it, and that is that the run will be made with the same amount of coal, but with more cars on the train or with a bigger load. While the saving (and this is a matter in my own work with my students which comes up right along), while the saving that you show in the run of a train may amount to a good deal in the course of a year, if you are able to make that saving, that makes a saving in the number of trains in a year. If you can do the work with fewer trains, if you can effect an economy which means more load in one train on a large road, fewer trains to do the work, the economy mounts up so much faster than the economy in running a single train that it becomes extremely important; and it seems to me that there is that side of it as well as merely reducing the number of tons of coal that you use in a particular run. This is important. In our engineering work we figure on things of primary importance and things of secondary importance, and in the matters of secondary importance are those things that affect the cost of a train mile. The things of primary importance are the things that affect the number of train miles, not the cost of the train mile; but if you can reduce the number of train miles, then you have done a tremendous thing. What has been said is important, not merely because of the saving in the cost of a train mile, but also in its bearing on the other side, which in many cases may be urged, of a reduction in the number of train miles, and it is surprising when you come to figure on anything of that sort how the figures count up,—what tremendous sums there are.

The President. Is there anything more to be said upon this subject? If not, we will close the discussion.

Mr. Bartlett. Mr. President, I move that this subject be brought up again at the next meeting.

Mr. Medway. I second the motion.

The President. You mean that it will be continued until our October meeting?

Mr. Bartlett. Yes.

(It was then voted that the subject of this evening's discussion be continued to the October meeting.)

The President. I hope that everybody will come here prepared to say something on the subject, to take up some records.

Mr. Medway. And make some records.

The President. Yes, make some records. Observe how trains are

made up; observe all that is going on on the roads, and give us all the points that bear on the subject in all its branches, and get all out of it we can. Maybe we shall have some of our superintendents in here with us who feel interested. This will be the last meeting before the convention, and it is the last meeting we shall have until October. As I have said before, the committee on entertainment will give you due notice of what the entertainment is to be. We generally have a pretty good social time. I know the last one was well attended, one of the best attended we have had, and I hope, whatever the entertainment may be, it will be well attended.

The SECRETARY. As most of the members are aware, the Master Car Builders' and the Master Mechanics' Conventions are to be held at Saratoga, beginning the 17th of June, and it has been the custom of this Club for some years to attend it in a body; such members as could go have gone in a body. There have been no arrangements made this year; but I would be glad to receive the names of all members of this Club who are intending to attend the convention. If you will write me in reference to the matter, stating whether you are to be accompanied with ladies or not, between now and the first of June, I will take the matter up and see what can be done, what arrangements can be made for transportation, whether we can go by a special train, if enough signify their intention of attending to warrant such a train. I know in some years we have gone in that manner. I have had one or two requests from members, and if those who intend going will write me to that effect between now and June first, we will see what we can do in the matter. (*Applause.*)

There being no further business to come before the Club, the meeting then adjourned, at 9.50 P.M. 98 members present.

NOTE.— The address of the Secretary is now Box 663, Springfield, Mass., instead of Box 1158, Boston, Mass.

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Caldwell, E. M., Eastern Car Heater Co., 50 State St., Boston, Mass.
Chamberlain, James W., Engineer, B. & A. R.R., Dorchester, Mass.
Crane, Thos. H., Foreman, Fitchburg R.R., Fitchburg, Mass.
Cutting, W. J., R. H. Foreman, N. Y., N. H. & H. R.R., Worcester, Mass.
Dane, Albert P., Foreman Painter, B. & M. R.R., Boston, Mass.
Eaton, Fred H., Pres., Jackson & Woodin Mfg. Co., Berwick, Pa.
Evans, H. W., Foreman, Keene, N.H.

Ewing, William D., Gen'l Supt., Fitchburg R.R., Boston, Mass.
Freeman, Henry N., R. H. Foreman, B. & A. R.R., Boston, Mass.
Greenwood, H. A., Foreman Inspector, Fitchburg R.R., Fitchburg, Mass.
Hough, E. W., H. W. Johns Mfg. Co., 119 Federal St., Boston, Mass.
Hutchinson, C. B., Inspector, B. & M. R.R., Lowell, Mass.
Lord, G. W., Foreman Painter, Fitchburg R.R., Fitchburg, Mass.
Lynam, John S., Signal Dept., B. & M. R.R., Boston, Mass.
McKibbin, C. H., 120 Broadway, New York City.
Mooney, W. R., Train Master, Concord, N.H.
Morrill, Ephraim, Foreman, B. & M. R.R., Lawrence, Mass.
Morrill, Fred H., Machinist, Fitchburg R.R., East Fitchburg, Mass.
Murray, Daniel, N. E. R.R., East Hartford, Conn.
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Paige, Chas. E., Thorndike St., Lowell, Mass.
Patterson, Andrew, Tinsmith, B. & M. R.R., South Lawrence, Mass.
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Perham, Alonzo L., 40 Salem St., Woburn, Mass.
Prescott, Emerson B., 183 West Brookline St., Boston, Mass.
Putnam, Chas. H., Putnam Machine Co., Fitchburg, Mass.
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Robbins, Milton, Fitchburg R.R., Fitchburg, Mass. [Dorchester, Mass.
Robertson, A., Train Master, Fitchburg R.R., Union Station, Boston, Mass.
Rockett, E. J., Blakeville St., Dorchester, Mass.
Scott, Walter M., Clerk, B. & M. R.R. Shops, Boston, Mass.
Smith, Edw. A., Supt. Tel., Fitchburg R.R., Boston, Mass.
Staddleman, W. A., Havemeyer Building, New York City.
Steele, Robt. J., M. P. Dept., N. Y., N. H. & H. R.R., Roxbury, Mass.
Stone, C. T., Station Agent, B. & M. R.R., Lawrence, Mass.
Sullivan, John, Yardmaster, B. & A. R.R., Boston, Mass.
Tait, John, N. E. R.R., 113 Beacon St., Worcester, Mass.
Walton, Eben A., R. H. Foreman, Fitchburg R.R., Charlestown, Mass.
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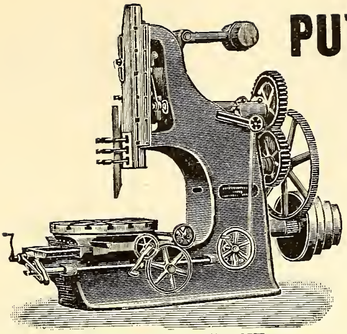

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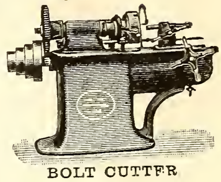

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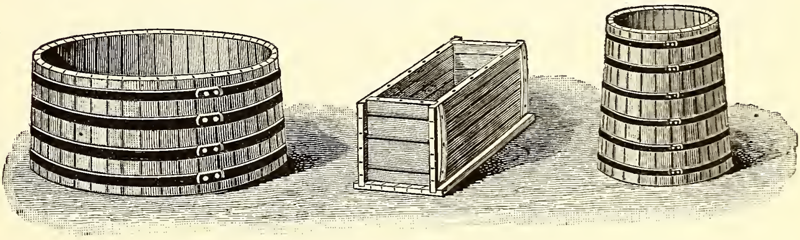

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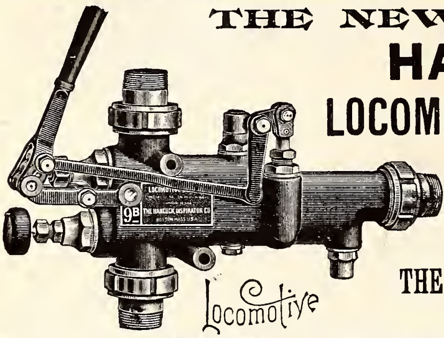

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PROCEEDINGS

OF THE

New England Railroad Club.

Meeting held at Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, November 10, 1896.

The President, Mr. L. M. Butler, called the meeting to order shortly after 8 o'clock, and said: —

The first item on the order of business is the approval of the minutes. No doubt you have all seen them in the printed report, and if there is no objection, they will stand approved. Are there any committees to report?

The Secretary. There are none.

The President. Any unfinished business?

The Secretary. None.

The President. Any new business?

Mr. J. T. Chamberlain. Mr. President, I suppose that it is known by most of the members present that this Club has lost one of its members, one whom everybody knew and had the most profound respect for. I refer to Mr. Osgood Bradley, who died Friday and was buried to-day; therefore I move that a committee be appointed to draft a set of resolutions in reference thereto.

(The motion was seconded and adopted.)

The PRESIDENT. I will appoint F. D. Adams, John Kent and George W. Peck. Our Secretary will read the names of the gentlemen who have been accepted as members of this Club this evening.

Edward D. Bolton, 180 Huntington Ave., Boston, Mass.; Henry M. Brown, Brown Car Wheel Works, Buffalo, N.Y.; W. B. Hammond, 10 Mt. Vernon St., Winchester, Mass.; Edson J. Quackenboss, 8 Hammond Street, Worcester, Mass.; F. B. Smith, Gen'l M. M., N. Y., N. H. & H. R.R., New Haven, Conn.; Geo. M. Trefts, Brown Car Works, Buffalo, N. Y.

The PRESIDENT. Is that all there is under the head of new business? If so, we will proceed to the discussion of the subject as announced: What are the Advantages of the Use of Cast Steel for Driving Wheel Centres, Driving Boxes, Cross-Heads and Frames? The subject now is open. We have with us to-night Mr. Sague, from the Schenectady Locomotive Works, who will read a paper which he has prepared on the subject.

Mr. J. E. SAGUE. I hardly expected to have this style of paper, gentlemen, but on going over the subject I found how true it is, as somebody has said, that you do not know how little you know on a subject until you try to write it up.

THE ADVANTAGES OF CAST STEEL FOR DRIVING WHEEL CENTRES, DRIVING BOXES, CROSS-HEADS, AND OTHER PARTS, IN LOCOMOTIVE CONSTRUCTION.

By J. E. SAGUE, *Mech'l Eng'r, Schenectady Locomotive Works.*

One of the most interesting of the recent developments in locomotive construction has been the increasing use of cast steel, and before taking up in detail the advantages gained, it may be of value to mention the general reasons which have lead to its wide substitution for cast and wrought iron. These reasons are, first, a desire to use as large a boiler as possible and the consequent lightening of the other parts as much as strength and durability will permit; second, the growing need for a stronger material than cast iron to withstand the increased strain of the large cylinders and high steam pressures used in modern locomotives; third, a desire to lighten reciprocating parts and thus reduce the effect of reciprocating counter-balances on the track; and, fourth, the substitution of cast steel for difficult and expensive forgings, which has been rendered possible and economical by the decrease in cost of

steel castings and the improvement in quality. In this connection the following is quoted from a letter received from the American Steel Casting Company : —

"The main point of advantage in the use of steel castings as a substitute for cast iron is the great saving in weight; and as a substitute for forgings is a saving in machine work, due to being able to cast close to finishing sizes. In other words, the substitution of cast steel spring saddles, foot-plates, driving boxes, pedestal caps, pistons, rocker arms, boiler roof bars, etc., secures lightness of detail combined with durability."

The necessity of obtaining the maximum of power with the minimun of weight is the feature of locomotive designing which, perhaps, involves the greatest difficulty and requires the most careful consideration of any condition by which the locomotive designer is limited, and in this, locomotive designing differs radically from that of stationary engines.

It is true that there must be sufficient weight on the drivers in all cases for adhesion, but the maximum weight per wheel must not exceed the safe figure for the track upon which the locomotive is to run, and the total weight is frequently limited by the maximum load allowed on bridges. On the other hand, train service requirements are constantly becoming more severe, and large increases in cylinder and boiler power are being made to meet the demands of high speeds and heavy trains.

For most passenger service, at least, the ability of the locomotive to do work is limited by its boiler capacity, and it is believed that the great demand upon the boilers of modern locomotives has been caused more by the increase in train speeds than by the increase of weights. With the maximum loads permitted on the rail it is often very difficult to use boilers large enough to do the work required, and it is necessary for the locomotive designer to lighten parts wherever possible in order to make up for the weight which must be put into the boiler. It is this necessity more than any other which has led to the increasing use of cast steel in locomotive construction.

The demand for a stronger material than cast iron, to withstand the strains of large cylinders and high steam pressures, has also been notable. The increase of strain due to high steam pressure is clearly shown from the fact that a 19 x 24 inch cylinder with 180 pounds of steam has more power than a 21 x 24 inch with 145 pounds, the higher steam pressure corresponding in this case to an increase in power of 24 per cent. Increasing the size of parts to correspond with such increases of power is difficult in many cases, and with cast iron, unfortunately, increase of section does not mean an equal increase of strength.

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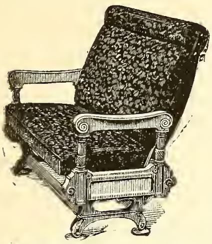

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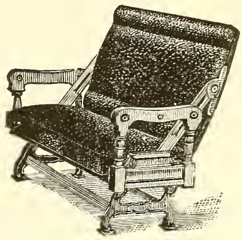

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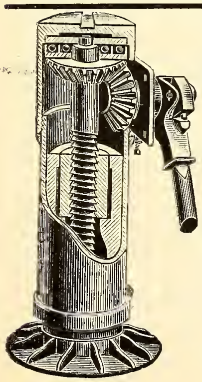

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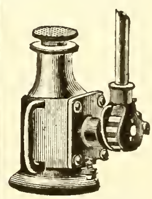

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20 lbs. weight.

The necessity of reducing the weight of reciprocating parts as much as possible does not need to be dwelt upon, and cast steel enters largely into the construction of the light reciprocating parts used in recent locomotives.

The superiority of cast steel over wrought or cast iron in strength and ductility is seen from the following tests taken from the records of the testing department of the Schenectady Locomotives Works. Average results from 140 tests taken from cast steel wheel centres applied to passenger and freight locomotives: tensile strength, 71,400 pounds per square inch; elongation, 19.2 per cent in eight inches. and 24.1 per cent in four inches. In each case the test pieces were cast on the wheel, one test piece representing each centre. The record of tests also shows the location of the wheel centres for each engine. For comparison it may be said that first-class cast iron has an average tensile strength of from 20,000 to 30,000 pounds per square inch with practically no elongation, and wrought iron a tensile strength of 48,000 to 50,000 pounds with an elongation of 20 per cent and upwards in eight inches. The figures thus show that cast steel suitable for locomotive use has nearly three times the tensile strength of cast iron and 50 per cent more than wrought iron. It also has the great advantage of high ductility, being nearly equal in this respect to wrought iron.

In order to realize the full benefit of the great strength of cast steel, however, much care must be exercised in the designing and manufacture of the castings. Cast steel has 50 per cent more shrinkage than cast iron, and is much more liable to unequal shrinkage strains, which, unless carefully provided for, will more than offset the high tensile strength. It is the practice of the works with which the writer is connected to ask the criticisms of the steel makers upon the design of difficult castings. such as wheel centres, and modify the distribution of metal accordingly. In general it may be said that the rules for correct proportioning of iron castings, regarding uniformity of section, large fillets, etc., apply with greater force to cast steel.

The use of cast steel as a substitute for cast iron generally increases the first cost of locomotives, the cost of the process and greater percentage of loss making the price per pound about three times that of cast iron, against which the saving of weight in most castings is only a small offset. The cost of machining is also considerably greater than for cast iron, as more finish is required to allow for unequal shrinkage, and the hardness and toughness of the metal requires the machines to be run at low speeds with light feeds, thus increasing the cost of labor and lessening the output of the shop. In some cases, however, steel castings may be substituted for difficult forgings with a saving in

first cost, but thus far this has only proved true for locomotive use in a few cases and with small forgings.

Steel castings are used in this country more or less extensively for the following locomotive details: — driving wheel centres, driving boxes, cross-heads, frames, pistons, expansion pads and knees, dome rings, rockers, and foot-plates.

The substitution of cast steel for cast iron for driving wheel centres in American locomotives has been very recent. The first steel centres applied by the Schenectady Locomotive Works were put in service May 1, 1895. Since then 500 wheel centres have been used in passenger and freight service, including locomotives now under construction. Thus far the principal use for steel driving wheel centres has been for large passenger engines, but quite a number have been applied also to freight engines. For passenger locomotives the main advantages of steel are its decreased weight and greater strength. A photograph which I have with me shows cast iron and steel centres 62 inches diameter, designed for the same service, the saving in weight with the steel being about 610 pounds per centre, or a total saving for a four coupled engine of 2440 pounds. I also have blueprints with me of different designs of steel driving wheel centres applied to passenger and freight engines. The strength and shock-resisting power with the steel centres, even with a lighter weight, is undoubtedly very much greater than that of cast iron; in fact, with sound castings, free from shrinkage strains, it is difficult to see how a steel centre can be broken except in a wreck. Great care, however, must be taken to avoid shrinkage strains. The rims are split in four places, which are carefully slotted and fitted tightly with planed cast iron plugs driven in so that the shrinkage of the tire will make the rim practically solid. Great care must also be taken in pouring the metal and while castings are cooling. The steel makers say, for instance, that the baked moulds are so hard and unyielding that if the sand is not broken away almost immediately after pouring, shrinkage flaws are almost certain to develop. An incidental advantage of steel centres, which is appreciated by the engineers, is the chance given for oiling and inspection through the large spaces between the spokes and around the hubs.

A difficulty involved in the use of cast steel centres is the necessity of providing for hub wear, as it is well known that cast steel does not wear satisfactorily against cast iron. This has been provided for by the use of cast iron or bronze hub liners, or a facing of babbitt or bronze on the driving boxes. Babbitt and cast steel are said to wear well together. Thirty locomotives recently built at Schenectady for the New York, New Haven & Hartford Road, with steel wheel centres and driving boxes, had the driving boxes faced with babbitt, the hubs of the

wheel centres being simply faced off as smooth as possible, and these are reported to be wearing very satisfactorily. Driving boxes faced with bronze are also said to wear well against cast steel.

Cast steel driving centres for freight engines allow of a considerable decrease of weight, but the advantage of increased strength is probably of even greater importance, especially for the main wheels, as all six and eight coupled engines must have the main rod connected to the outside of the crank-pin, thus exerting great leverage on the wheel centre around the crank-pin hub. When made of cast iron, these parts must be very heavy, and even when all possible has been done in design and material, cast iron main wheel centres are liable to give some trouble from cracking on heavy engines. It is believed that this might be entirely overcome with well constructed steel centres, and the lightening of the hub and rim which could be obtained would allow of increased counter-balance being put in the main wheel, as in small driver engines. with cast iron centres, the balance on main wheel must often be deficient.

For driving boxes, cast steel has thus far had but limited use in spite of its great strength and the trouble experienced with broken cast iron boxes. The roads having the most experience with cast steel boxes, as far as the writer knows, are the Boston & Albany and New York, New Haven & Hartford. Probably one of the main objections to a more extended use of steel boxes has been the fear of bad results from wear between the box and wheel hub, and at the wearing surfaces of the shoes and wedges. Babbitt or bronze facing, however, seems to settle the question of hub wear satisfactorily. The large steel driving boxes fitted up for the New Haven engines, before referred to, had no special provision made for wear against the shoes and wedges, and we are assured that the results in service have been most satisfactory. Assuming that the wear can be made satisfactory, it is believed that steel boxes are destined to be quite generally used. Compared with cast iron they give great strength and freedom from breakage, can be made to save considerable in weight, and the flanges can be reduced in thickness, if desired, and thus allow the shoes and wedges to be widened to give more wearing surface. Steel boxes, also, being much stiffer than cast iron would have less tendency to spring when the brass is pressed in. As compared with solid bronze, steel boxes expand less with heat and can therefore probably be run with a closer adjustment of wedges. The following letter received from Mr. John Henney, Jr., Superintendent of Motive Power of the New York, New Haven & Hartford Railroad, gives very valuable information on the subject of the wear of steel boxes :—

"In reply to your favor of the 5th inst., would say, that we have used steel driving boxes for two or three years before we had the last new

engines built at your works. We also used them with babbitt facing, same as those built at the Schenectady Locomotive Works, and find they work very satisfactorily indeed.

"We have no trouble from using the cast iron wedges in contact with the steel driving box. These wedges are kept as close as they were formerly with the cast iron boxes, and with better results.

"The babbitt facing on the boxes wears well. You can scarcely measure the difference after a year's wear, and a year's wear on these engines frequently means 120,000 miles."

Cast steel is more widely used for cross-heads than for any other detail in locomotive construction. Cross-heads, of course, should be made as light as possible consistent with ample strength and bearing surface, and the use of cast steel enables this to be done more effectually than with any other material. The photograph and drawing show the latest pattern of cross-head used by the Schenectady Locomotive Works on 20 x 24 inch locomotives carrying 190 pounds of steam. The wings and wrist pin are cored hollow, decreasing the weight about fifty pounds as compared with a solid cross-head, without any sacrifice of bearing surface or practical decrease of strength. The total weight of this cross-head, fitted with bronze gibbs ready for service, is 157 pounds. The centres for the "H," or Pennsylvania Railroad, style of cross-head are also best made of cast steel, and it is believed that cast steel Laird cross-heads can be so designed that the objection to this type on the score of broken piston rods can be practically overcome, especially if the rods are made with enlarged cross-head fits.

Cast steel frames are as yet only matters of experiment, and it is too early to give a very decided opinion regarding their advantages or otherwise, compared with hammered iron. The probable advantages that suggest themselves are as follows: All welds being avoided, the risk of breakage due to poor work is reduced, especially as the material in them is stronger and tougher than wrought iron. The Schenectady Locomotive Works, however, has long made it a practice to take three heats on each frame weld, and it is believed that this makes it almost certain that the frames are as strong at the weld as in any other part. Steel frames would admit of greater latitude of design than those of iron, as iron frames must be constructed with a view to easy forging and welding, and it seems probable that steel frames, if largely used, will lead to important modifications in design. It is possible, for instance, that the bars might be made of "T" or "I" section, thus reducing the weight without sacrificing strength. The weakest parts of wrought iron frames, aside from possible defective welding, are through the bolt holes, and at these points the metal could be retained at full thickness and reduced elsewhere, thus keeping the net section nearly

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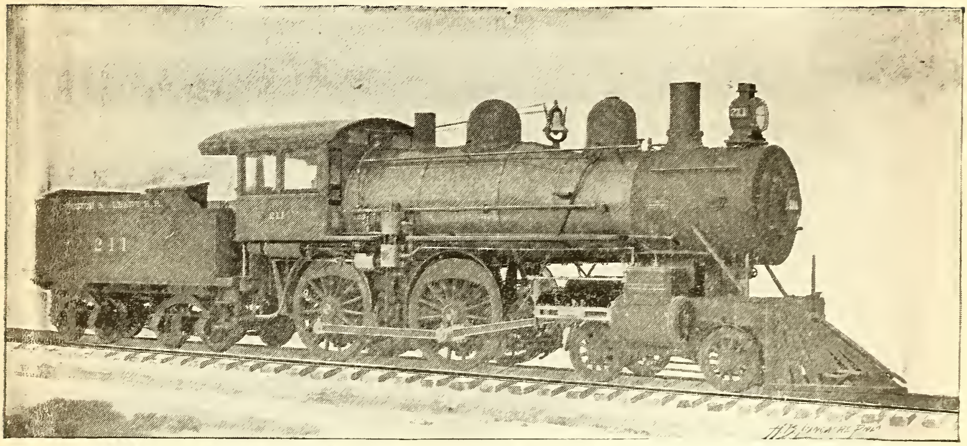

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uniform. An objection to the use of cast steel which naturally occurs to one is the difficulty of repairing breakages. Cast steel in small sections can be successfully welded, but probably in larger sections the difficulty of securing a good weld will be much greater than with iron. I quote the following on this subject from a letter of the American Steel Casting Company: —

"In reference to engine frames, beg to say that while we are strong advocates of cast steel frames, our experience in this direction has been rather limited, and although we have furnished a number of engine frames, we have no data at hand at the present time that would indicate what results have been obtained from their use.

"As a preliminary opinion, we beg to say that the substitution of cast steel frames in the place of wrought forged would practically eliminate all objectionable features found in the wrought forged frames, and at the same time combine all their advantages.

"The price of cast steel frames is an inducement, as we are able to furnish these frames at less money, either in the rough or finished, than that at which the wrought forged frame is being produced."

Dome rings made of cast steel have been largely used by the Schenectady Locomotive Works, and make a very successful job. In this case, however, it is being superseded by hydraulic flanged steel, which is believed to be the best of any material for the purpose. The use of steel in expansion pads and knees, foot-plates, guide yoke and bumper knees, frame filling pieces, and similar locomotive details, is constantly extending. The main object, as before mentioned, is to save weight for the purpose of allowing increase in the size of the boiler. In all these cases, of course, very considerable gain of strength is secured, which will result, no doubt, in decreased trouble from breakage, and the use of cast steel will probably extend to a great many other details than those mentioned. In English practice cast steel is used to a considerably greater extent than with us. Mr. Hughes' book on the construction of the modern locomotive speaks of forty parts being thus made, among others, mud-rings, guide yokes for inside connected engines, and crown bars. Even cast crank axles have been used to a very limited extent.

The more general introduction of cast steel is delayed by its high cost, the increased expense of machining, and the uncertainty of securing sound castings and prompt shipments. This often leads to unexpected delays in completing contracts for locomotives for which cast steel is largely specified, and causes expensive and annoying delays in the builders' shops. Many of the disadvantages which we have noted, however, are incident to the rather sudden demand for this material in

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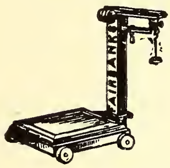

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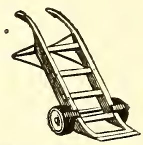

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many recent designs of locomotives, and will no doubt be largely overcome as steel gets into more regular use, and the locomotive designer has reason to be thankful that in endeavoring to meet the severe requirements of modern train service, he can command the use of a material so well adapted to his needs.

The PRESIDENT. We have with us a representative of the Midvale Steel Company, of Philadelphia, Mr. W. P. Barba. I believe he has something to say about steel castings.

Mr. W. P. BARBA. Mr. President and gentlemen, I was asked to prepare a short list of tests and sundry remarks of our experience with steel castings for railroad work, and these few remarks were prepared independently of any knowledge of Mr. Sague's endeavor in the same direction, and necessarily they will cover in a slight degree the same ground, which I trust you will pardon. You will notice as I proceed the points to which I refer.

STEEL CASTINGS FOR RAILROAD WORK.

By W. P. BARBA, of Midvale Steel Works.

The use of steel castings for railroad work has recently attained a much more prominent and important position than has heretofore been accorded to them, and one well worthy of consideration. The adaptability of steel castings for all, or nearly all, purposes where iron castings were formerly used exclusively, has compelled the attention of the progressive railroad men of the country to the securing of proper designs for steel castings for all cast parts of locomotives where occur the greatest and most frequent strains. This is the natural sequence of the experience of railroad men and locomotive builders with forgings; steel now replacing iron in every part of the engine where shocks are most frequent and strains greatest. Tires, piston rods, connecting rods and axles, formerly made of iron, are now being made of steel, while for crank-pins, demands are daily made for steel with qualities exceeding that required by the Government for its very expensive ordnance.

It is therefore somewhat strange that steel castings have been so long in obtaining from the railroads the recognition they really deserve. Satisfactory castings are not difficult to obtain; they are not a recent product, and the study of their manufacture by the best metallurgists of the country has brought it up to a remarkable condition of excellence. The first successful steel casting made in America was in 1867, and was a frog for the Philadelphia & Reading Railroad. This was made at the Midvale Steel Works by a man who has been continuously employed

there in making steel castings from that time to the present. During this period there has been a steady advance in the character and quality of steel castings, in the grade of metal put into them, and in general excellence of appearance.

I have no hesitancy, therefore, in asserting that to-day steel castings may be obtained of a character and quality closely approximating ordinary forgings, and far excelling in reliability and the amount of hard usage they will stand any iron castings produced. As a result of this marked advance in the character of steel castings produced, the substitution of steel castings for iron becomes a matter of present importance to the railroad constructor. The use of steel castings will permit the employment of lighter sections, lesser weights of moving parts, — always a desirable thing, — and provide greater strength and assurance of safety.

With your permission we will compare an iron wheel centre with a steel centre: In the iron wheel you have a metal with a T. S. of say 25,000 lbs., and with no elasticity whatsoever; in the steel wheel you have a metal with an elastic limit of 35,000 lbs. — 10,000 lbs., or 40 per cent, greater than the ultimate strength of the cast iron wheel, while the ultimate strength of the steel wheel is 65,000 to 70,000 lbs., with an elongation after fracture of 20 to 30 per cent, a breaking strength two and one-half to three times that of cast iron.

It is obvious, therefore, that the weight of each wheel may be reduced in accordance with the wishes of the designer, so that a material reduction in the weight of moving parts may be obtained and with it a great increase of strength and stability.

I have in my office a photograph of a cast iron wheel beside a steel wheel, both designed for the same type of engine; the iron wheel weighs 2,400 lbs. and the steel wheel 1,800 lbs., a reduction of 600 lbs., or 25 per cent, in weight, the steel centre being moreover much stronger and more graceful in appearance.

Leaving the question of wheel centres for a moment, I would call your attention to the fact that cast steel is especially adapted for cross-heads, which you will agree with me is a vital point in an engine. Should a cross-head break in service, the amount of damage which might ensue is perfectly appalling to contemplate. Therefore the most careful attention of designers should be directed to securing simple, safe and strong types of cross-heads, and this end can be best attained by the use of cast steel. In this connection let me say that the simpler the design, the more satisfactory the result; complicated shapes and sections, while pretty on paper, are not generally desired by the mechanical and operating departments. I have seen a large number of designs of cross-heads go through the foundry, and in every case the survival of the fittest was the survival of the simplest.

The subject of cast steel driving boxes should scarcely require comment. The part that first receives and transmits the shock of service should be above suspicion, and the use of cast steel for this purpose would be a long step in the right direction. In a prominent locomotive shop the other day, I saw piles of boxes of both steel and iron, and the large proportion of steel boxes shows that experience has proven the utility of steel for this purpose.

Cast steel frames, I think, would be an innovation on American locomotives; and yet, one has but to see the large force of men, first-class blacksmiths, laboriously welding up wrought iron frames; and the heavy tools used in machining off the comparatively large amount of excess metal, left on by the inexact method of building up, to realize the advantages of a casting, close to pattern, requiring but little to be taken out of the box squares, etc., and having a homogeneous structure throughout, instead of the doubtful welding of large iron parts. Not much has been done in America in the matter of cast frames, but abroad Krupp is turning them out constantly, and they give great satisfaction for the very reasons which I have enumerated. I would like to see American constructors take up this matter, and I feel confident that the steel casting manufacturers would produce cast steel frames of soft, well annealed steel, which would meet with the entire approval of all the parties interested.

In addition, dome tops, rocker arms, eccentric straps and pistons have been made in our foundry with excellent results, and the growth of the demand for these parts justifies me in saying that it is only a question of time when a much more extended use of steel castings will be made in locomotive construction.

I would call your attention to some tests of cast steel for railroad work, made at the Midvale Steel Company's Works during the past year, and representing wheel centres and cross-heads, dome tops, pistons, eccentric straps, etc. Two groups of tests are shown, the softer than that which is generally furnished, and the harder, a class which was specially requested.

Group I. shows extremes as follows: —

	T. S.	E. L.	Ex.	Contr.
	61,500	29,500	32.8	54.1
	69,500	34,500	22.9	30.9
Average of 32 specimens,	66,239	33,415	30.8	49.8
Group II.				
	70,000	36,000	31.6	48.2
	79,430	38,190	23.8	30.1
Average of 25 specimens,	73,266	36,900	27.8	41.3

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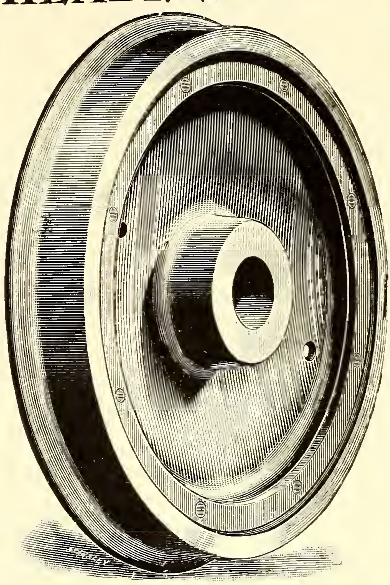
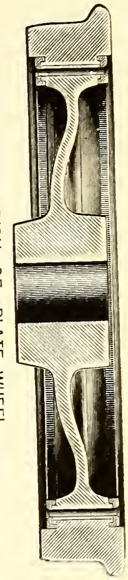


SECTION OF PLATE WHEEL.



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These tests will give you an idea of the characteristics of the metal used for steel castings, and a comparison with iron will show the enormous advantage possessed by steel; iron for wheel centres, where low shrinkage is desired, averaging but 23,000 lbs. per square inch.

To further compare cast iron with cast steel, some transverse tests of steel bars were made. Bars were prepared 1 x 1 x 14 inches, placed on supports 12 inches apart, and a load applied to the centre of bar, copying in all respects the English specifications for transverse tests of cast iron. Applying a load of 2,680 lbs. and measuring, the deflection was found to be .033 inch as against .065 inch for cast iron. Continuing the application of load to 3,200 lbs., the transverse strength of good cast iron, a deflection in the steel bar of .050 inch was observed. On releasing the load the bar resumed its original dimension, no permanent set whatever being observed — this, remember, with a load that is the average breaking strength of the best grades of cast iron. After this, load was applied as before, but not measured, until the bar was bent cold through 180 degrees, without showing any sign of failure. This test can be duplicated at any time, the cold bend being the favorite test of the construction department of the Navy.

Now, when an iron casting breaks, it goes all at once, without any deformation of section. This is due to its granular structure and its lack of elasticity; and no amount of care in making the casting can provide against it. Designs for cast iron parts must necessarily take this into account. When, however, an undue strain is put upon a steel casting, its great elasticity, exceeding, as I have stated, the ultimate strength of the best grades of cast iron, permits it to return to its normal condition. If the strain be too great and the elastic limit be exceeded, the cast steel part would deform, and that would be noticed at once and corrected. This is especially true of castings carefully annealed, an operation constantly practised at the Midvale Steel Works on all castings for railroad work, and necessarily practised on all castings for the Government, the specifications requiring all castings and forgings to be annealed.

Permit me to add that the firms capable of producing satisfactory steel castings for railroad work are distributed widely enough to meet the requirements of New England consumers with promptness: The Benj. Atha & Illingworth Co., of Newark, N.J.; The Penn. Steel Casting Co., at Chester, Penna., whose work is so well spoken of by Captain D. A. Lyle, the well known Ordnance Engineer, and the numerous foundries of the American Steel Casting Company at Thurlow, and many other establishments of established reputation who are daily turning out work of superior character at prices much lower than those current in Europe. It is undoubtedly due to the conscientious work of the men

at the heads of these departments that is to be ascribed the rapid growth of the steel casting industry of the country, and the excellence of the out-put could not be maintained if it were not for the assistance received by them from the practical men in charge of the motive power of the railroads of the country.

The President. Gentlemen, you have heard the papers which have been read by these gentlemen. I do not know as there are any more papers to be brought forward. There is now an opportunity for any person present to speak upon the subject.

Mr. Henry Bartlett. Mr. President, I would like to ask either of these gentlemen who have spoken, if they can explain to me why cast steel will not run in contact with cast iron. We have all tried to make it do so and know it won't, and I would like to know mechanically why it won't. We have tried to run cast steel cross-heads on cast iron guides, and have not been able to do that. It is said that cast steel driving boxes won't run against a cast iron hub without some kind of a lining. Just why that is I would like to know. I have never been able to get at the facts.

The President. It may be one of these gentlemen conversant with steel construction will be able to tell you.

Mr. W. W. Whitcomb. Mr. President, as some of you know, I had something to do with the American Steel Wheel Company, before they moved from Boston, making the Nathan Washburn all steel wheel, as it was termed. We first began to make those wheels with an iron sleeve in the hub; and I will give you a little experience which we had there, which may possibly answer Mr. Bartlett's question. We made quite a number of wheels that way, but found in breaking them that there were instances where the cast iron had melted and flowed, extending into the rim of the wheel. Mr. Washburn's theory was that the steel was so much hotter (I have forgotten now the proportion), but so much hotter, than the iron that when it struck the iron it melted, and we found the iron distributed even so far as the rim of the wheel. He put it on the ground of the steel being so much hotter than the iron.

Mr. Sague. I think it is only fair to say in response to Mr. Bartlett's question, as to the reason why cast steel does not wear well in connection with cast iron, that speaking from my experience, simply to say that it does not, but why I am unable to say.

Mr. Barba. Mr. President, I would like to reiterate the same remark. We have been hunting for the reason why for several years, and have not been able to find out yet. I have spoken to one of the brightest engineers it has been my good fortune to meet about that very thing, and he informed me he did not know the reason. I do not know, and do not believe any of us know. The matter is under consideration

now, and serious study is being given to it at the present time by this same man, and has been for three years past. I know he has not had any light yet thrown upon this matter.

The PRESIDENT. The subject is, "What are the Advantages of the Use of Cast Steel," etc. I did not know but there would be some one present, after the advantages had been shown, who would bring up the negative argument as to disadvantages.

Mr. T. B. PURVES, Jr. Mr. President, I do not want this discussion closed right here. The advantages that the Albany Road have experienced in the use of steel driving wheel centres is very practical. The last consignment of locomotives received from the Schenectady works had wheel centres made of cast steel, with a reduction of about 600 lbs. per wheel. This gave us an oportunity to increase the diameter of our boiler, which we did, increasing it from sixty to sixty-two inches.

This increase in the diameter of the boiler gives thirty more tubes, which gives a corresponding increase of heating surface, which was all a practical benefit. We have been using steel driving boxes, I think, since 1882. When our B. & A. standard engines were designed it was calculated to use cast iron driving boxes in them, but it was very quickly demonstrated that the cast iron was not equal to the emergency, and all the engines that had been built up to that date had steel driving boxes substituted in them, and all engines built after that date had steel driving boxes. We were obliged to line the outer surface, that is, the hub bearing of the driving box, with Babbitt metal. When we first applied the steel boxes we allowed the shoes and wedges to wear against the steel surface of the box, and after running that way for a time it was demonstrated that the two metals, cast iron and the steel face of the driving boxes, did not wear well together. We planed our driving box down, and secured a cast iron liner half an inch thick on each face of the driving box, and since then we have experienced no trouble whatever. I cannot recall now the fact that we have ever had a broken steel driving box.

On the subject of steel frames, it is something that none of us know a great deal about. I do not doubt that many of us would be a little bit fearful of ordering locomotives with steel frames, although the sample shown at the Master Mechanics' Convention at Saratoga looked excellent. That showed that they were able to stand great stress, great contortion; and yet, when put into actual service, there are none of us today who are able to say that they would be superior to the wrought iron frame.

We have with us to-night a face familiar to us all. I refer to Mr. James Smith, of the Boston Forge Company. I know he is able to say something of interest on this subject. He will take the negative side of this argument.

Mr. James Smith. Mr. President and gentlemen, in regard to iron locomotive frames as compared with steel, of course I am prejudiced in favor of iron. I think there will be great danger in manufacturing locomotive frames out of steel, because you cannot tell with certainty whether you will get a sound casting or not, and the first knowledge that you would have of the unsoundness would be from its breaking. In forging steel we cannot tell what the inside is. We forge a great many crank shafts of various kinds, single, double and treble crank shafts, and when we cut out the throw we very often find defects. After hammering a forging from a large ingot down to the proper size that is required for the crank shaft, I have seen defects large enough to put a hen's egg into. Of course there is no mortal man who can tell what defect is there until you cut into it. Now, the liability would prove the same in forging locomotive frames. It would cause an uncertainty in the mind of the builder as to whether or not that frame was sound, and that is not a pleasant thing for a manufacturer to go to sleep on. A manufacturer of forgings of every description, or a car wheel maker, ought to leave no stone unturned to get the best article of forging that can possibly be produced that goes into a locomotive or any part of a railroad car. (*Applause*). If I knew that I was going to lose a dollar or two on a car axle, if the price was so low, — if I found out after I took my contract that I was going to lose a dollar upon every axle that I made, I would make those axles just as good as though I made a dollar. The man who would do otherwise is a rascal to begin with, for he might be the means of causing the loss of a hundred lives. There are some things, Mr. President and gentlemen, that are better than money. A life well spent in a mechanical line of business, with an unselfish aim to always produce the best article of work that material and labor will produce, will bring satisfaction to any man's heart. (*Applause.*) Therefore I say that the railroad companies of the United States or any other nation that will buy an article because it is cheap, not knowing certainly whether they are going to get as good an article as can be produced, have a great responsibility resting upon them. Railroad companies ought to be willing to pay a price that will enable any man to do an honest job and have a fair profit for doing it. It would encourage a dishonest man to be more faithful than he would be otherwise.

Now, after forty-nine years' experience in working iron, I would hesitate very long before I would use steel for locomotive frames, for the reason set forth, and many other reasons which you educated railroad mechanics could set forth better than I. Gentlemen, I did not intend to say anything, and I do not know whether I have said anything or not.

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The PRESIDENT. Mr. Medway, you look as though you had got something you want to say.

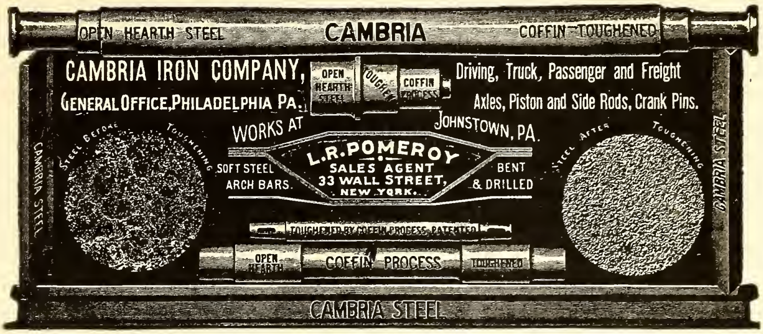
Mr. JOHN MEDWAY. Mr. President, it has been suggested that our President has had considerable experience with driving boxes made of cast steel, and we would like to hear from him.

The PRESIDENT. I have nothing to say in addition to what has already been said. Several years ago I determined to put in some steel driving boxes; it was as long ago as 1889, and I was not sorry I put them in. I found I could force my linings in by twenty-five tons pressure, and they staid there, and did not spread the box open very materially. It would be hard to measure the amount they spread. I did not cut away the steel for the lining. I simply drilled in with a flat nose drill, and hammered it down and pressed it up so as to leave about one sixteenth of steel. I never had any trouble with it and never had any cutting. I considered I had done the right thing, and I never have had any broken boxes. I only wish I had them all made of steel, as I have had to substitute new boxes in place of broken ones in several cases within a few months. Further than that, I can only repeat what has already been said.

Mr. H. C. JOHNSTON. Mr. President, I have an associate in New York, a mechanical engineer of large experience, Mr. A. B. Frenzel. He is present to-night. I would like to have you call on him.

The PRESIDENT. We shall be glad to hear from Mr. Frenzel.

Mr. A. B. FRENZEL. Mr. President, in regard to the wear and strength and the difficulty in determining a fracture in steel castings, I have had more or less experience. Some years ago, I think about twelve, I designed a very large vacuum pan, with a vertical shaft about six inches in diameter, and with a stirrer on the bottom about seven feet in diameter, turned up at the sides two feet. In machines of this character we first made use of cross bars made of wrought iron. The Delancater Iron Works made the stirrers of eight inches by one and one half inches cross section, and the machines rendered acceptable service, but we found that on account of the tremendous stress that came upon the stirrer, the wrought iron was getting out of shape; that is, the bars turned and got a little bit out of true. We had a great deal of difficulty in keeping the knives on the sides of the machine. In order to obviate that difficulty we made a very heavy casting of cast iron that carried, I think, about one and one half or two per cent of aluminum. It was cast and annealed, and was one of the finest pieces of cast iron that I ever saw. We were troubled with that by its springing away from the sides and causing a thin film to gather. This was a machine that was drying milk to a powder, probably the most difficult material in the world to handle. After that I think we started in on five feet spreaders



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that came from the Midvale Steel Company. Now we have got up to seven and eight feet in diameter, and only lately a very large steel forging was made for an eight-foot pan, I think by the Midvale Steel Company. A short time ago I had one of these vacuum pans built by the Pond Machine Tool Works. The heavy steel forging made by the Midvale Steel Company, in a seven-foot machine, in service has made over 50,000,000 revolutions, and it is just as true to-day as it ever was. I have tried cast steel with pretty good results. The stirrers are now made with cast steel arms. If there is any spring, they invariably go right back to the original position.

Now, to give you some idea of the service that this heavy cross bar is put to on these large machines, I will say the shaft is eight inches in diameter, driven by a spur wheel eight feet in diameter. It is driven by a seventy-five horse-power engine, on a forty-inch pulley, driving a twelve-inch pinion, but sometimes the pan comes pretty near getting stuck.

I have spent some years in Paris, and at a celebrated place where they make steel castings I saw a mechanic going over a steel casting with a very small hammer, similar to the hammers that are used by saw makers in taking out buckles in flat steel. I asked why that was done, and was told that a man with that hammer could detect a flaw in a casting. It is known by the sound. I know that to be so, because I believe that is carried out by two or three of the very large manufacturers of steel castings in England and France.

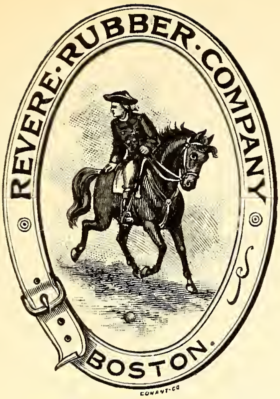
I have lately had quite a number of steel castings made, some sixty pieces, by a firm in Philadelphia. The name of the firm who made those casting I do not know. These castings were for a machine with discs and arms making 1,800 revolutions a minute, for crushing stone to an impalpable powder. As the result of my judgment, I have used steel castings in this high speed machine. If the castings get out of shape at all, they can be straightened without any trouble whatever, and can be brought right up as true as a die, and there has not been a single bit of tool work on them. They are as exact as any machine can make them. I have used cast steel in preference to a steel forging, or wrought iron forging, and have cut down the cost of construction nearly sixty per cent, and also cut down the weight on the same machine over thirty-five per cent. Now, if you were driving a rapidly revolving shaft, a large one, with its load of 350 pounds, and were going to drive that with an electric motor, as I expect to later on in these machines, a breakage in that machine would tear it all to pieces. I tested every one of these steel castings with a hammer myself. I threw one out and broke it and found a flaw in it. That piece of steel is eight inches by four, and I detected a flaw in that. That is only one out of sixty pieces.

I think if this matter is investigated by a man who has a delicate sense of hearing, and particularly a man such as you can get in Philadelphia, who straightens and takes out the buckles in wrought or steel plate, with a very small hammer, — I do not think the hammer weighs over six ounces, or over eight ounces at the outside, — it will be found he can detect flaws in steel castings in a few minutes, as I have seen it done.

Now, as to the other question which was brought up, about the difference in wearing qualities between cast iron and steel, I illustrate it in this way. The grain of cast iron is really much coarser than that of steel. If you take two pieces of emery cloth, one piece very fine and the other rather coarse, and rub them together, you will find that you make hardly any impression whatever on the fine emery cloth, but you will rub down the sharp points and angles on the coarse emery cloth; and in almost all cases any metal of very fine texture and close grain will invariably wear better than the metal that has a coarser grain. To prove that I will give you a further illustration. I will take a shaft of steel running in an ordinary bronze box. Steamers that run between Dover and Calais on the continent of Europe, or between England and France, are unusually high speed boats, I suppose, for their size. They are considered about twenty-one or twenty-two knot passenger boats. One of the things the engineers hate to do is to reverse their engines on those boats; and I was in the engine-room one day, — I frequently go down in the engine room because I can learn many things there, — and I asked the engineer why he hated to reverse his engine, and he said, "After a while the steel shaft has little particles on it like the scales on a fish. You can see them with a microscope. The moment I reverse my shaft I am liable to get a hot box. My box gets hot because the points of those little scales are liable to turn outward, and my boxes don't last anywhere near so long if I am continually reversing." That may be theory, but at the same time, I believe there are gentlemen here who have had engine practice who will say by reversing your engine or reversing a high speed machine, you will get a hot box.

I do not know that that is a fair answer to the question, but I think that you will find this difference due to the difference in the size of crystals of steel and cast iron. I came here to-night to hear other people talk, because I am a good listener. At the same time I can only give you the results of my experience, and it has taken me about fifteen years of hard work to find out the superiority of steel castings. I have tried everything in the shape of wrought iron and steel forgings and therefore have come right down to cast steel. I believe I am going to stay there. (*Applause.*)

The President. If there is nothing further that any member wishes to say on this subject, I will declare this discussion closed. I so declare



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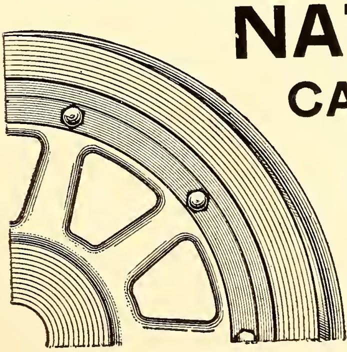

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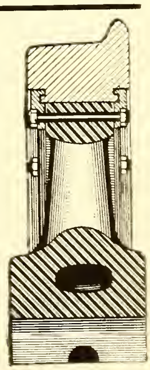

it. The subject that will come before this Club in December is as follows: "First, is it desirable to abandon the use of dummy couplings for air-hose? Second, what are the best and most economical forms of boiler coverings?" Is there any member who has anything to offer for the good of the Club at this time?

Mr. PURVES. Mr. President, I move that the thanks of the Club be extended to Messrs. Sague, Barba and Frenzel for their papers and remarks which they have given us this evening.

(The motion was seconded and adopted.)

The meeting then adjourned, 9.30 P.M.

102 members present.

NEW MEMBERS.

Bolton, Edward D., 180 Huntington Ave., Boston, Mass.
Brown, Henry M., Brown Car Wheel Works, Buffalo, N.Y.
Hammond, W. B., 10 Mt. Vernon St., Winchester, Mass.
Quackenboss, Edson J., 8 Hammond St., Worcester, Mass.
Smith, F. B., Gen'l M. M., N. Y., N. H. & H. R.R., New Haven, Conn.
Trefts, Geo. M., Brown Car Wheel Works, Buffalo, N.Y.

CHANGE OF ADDRESS.

Appleyard, W. P., M. C. B., N. Y., N. H. & H. R.R., New Haven, Conn.
Medway, Fred. J., Fitchburg R.R., Keene, N.H.
Rice, Edmund, B. & A. R.R., Springfield, Mass.
Young, Wm. W., 1301 Havermeyer Building, New York City.

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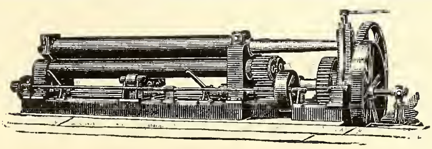

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